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PROCEEDINGS OF PUBLIC MEETING ON WATER QUALITY MANAGEMENT FOR ESTUARIES, HELD IN SAN FRANCISCO, CALIFORNIA, ON FEBRUARY 18-19, 1969. VOLUME 2

Federal Water Pollution Control Administration
San Francisco, California

19 February 1969

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CLEAN WATER

....FOR THE NATION'S ESTUARIES

PROCEEDINGS
PUBLIC MEETING
ON
WATER QUALITY MANAGEMENT
FOR ESTUARIES
SAN FRANCISCO, CALIFORNIA
FEBRUARY 18-19, 1969
VOLUME 2 OF 2

March 3, 1849

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FEDERAL WATER POLLUTION CONTROL ADMINISTRATION • U. S. DEPARTMENT OF THE INTERIOR
PACIFIC SOUTHWEST REGION   SAN FRANCISCO, CALIFORNIA

349

PROCEEDINGS

PUBLIC MEETING
ON
WATER QUALITY MANAGEMENT FOR ESTUARIES

VOLUME 2 OF 2

STATE OF CALIFORNIA

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

February 18-19, 1969

State Office Building
San Francisco, California

I

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INTRODUCTION

Volume 2, Proceedings, Public Meeting on Water Quality Management for Estuaries, February 18-19, 1969, San Francisco, California, continues the compilation of Statements and Reports for the Record of this public meeting. The Foreword of Volume 1 describes the concept and intent of the National Estuarine Pollution Study.

STATE OF CALIFORNIA — RESOURCES AGENCY
RONALD REAGAN, Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814

G. Ray Arnett - Director

March 14, 1969

Mr. Irving M. Terzich
Pacific Southwest Region
Federal Water Pollution Control Administration
760 Market Street
San Francisco, California 94102

Dear Mr. Terzich:

At the public meeting on water quality management for estuaries held February 18, 1969, we indicated that we would supplement our oral statement with a written report. The report is enclosed.

We would appreciate the inclusion of our report into the transcript of the California meetings.

Sincerely,

L. H. Cloyd

FOR Director

WRITTEN STATEMENT BY THE DEPARTMENT OF FISH AND GAME FOR THE PROCEEDINGS OF FEDERAL WATER POLLUTION CONTROL ADMINISTRATION HEARINGS IN CALIFORNIA

This statement is additional information on California's estuarine resource referred to in the oral presentation made at the hearing in San Francisco on February 18, 1969. Some of the information is also provided in a report submitted to the FWPCA through the State Water Resources Control Board, Division of Water Quality. The latter report basically provided technical and other factual data as input for a report entitled, "A Profile of State Programs and Activities Related to the Estuaries of California."

This statement will be addressed to answering those questions provided by FWPCA as guidelines for presenting information at the hearings:

1. What are the values (aesthetic, personal, recreational, dollar, etc.) of California's estuarine resource?

The primary concern of the Department of Fish and Game with the estuarine environment pertains to the ability of an area to support fish and wildlife. Value assessments of the estuarine environment will therefore be limited to those attributable to the fish and wildlife resource.

The Department of Fish and Game has an active bay and estuary study and planning program. At this writing fish and wildlife plans are being prepared for eleven estuarine areas in California, 10 of which will be completed in 1969. These plans will contain documentation of fish and wildlife values of the estuarine environment. Already completed is a fish and wildlife plan for San Francisco Bay and Delta prompted by legislative action in 1965. Summarized below are the fish and wildlife values of San Francisco Bay and Delta:

The fish and wildlife resource depending upon the San Francisco Bay-Delta environment now supports 3.5 to 5 million man-days of recreation and an ocean commercial fishery that lands 5.7 million pounds of salmon. The resource is compatible with increased use of the Bay-Delta and providing that we solve the problems of water quality and some other changes in the environment, its value is expected to about triple in the next 30 years.

A large and varied fish and wildlife resource depends upon the maintenance of satisfactory environmental conditions throughout the San Francisco Bay and Delta. Many are migratory species whose populations migrate in or through the estuary according to long established patterns of seasonal changes in the environment. Most important is a large and well-used striped bass (Roccus saxatilis) population that supports a fishery of between 1.5 and 3 million angler-days per year. Most individuals of this population spend most of their lives in the San Francisco Bay and Delta, although some adults spend time at sea and many ascend the Sacramento and San Joaquin rivers above the Delta to spawn.

The largest king salmon (Oncorhynchus tshawytscha) stock in the world moves through the Bay and Delta on its way to spawning grounds in the Sacramento and San Joaquin River systems. The young produced by this spawning migrate downstream through the estuary on their way to the sea and ultimately produce approximately 5.7 million pounds of salmon in a commercial ocean fishery and 187,000 man-days of recreation in the ocean and in the rivers above the Delta.

There is also a large American shad (Alosa sapidissima) run through the Bay-Delta and a growing shad fishery upstream, a sturgeon population and growing fishery in the bay, a resident catfish and centrarchid fishery in the Delta, a very important pier and shore fishery in the bay, and an excellent steelhead (Salmo gairdneri) run and fishery in the Sacramento and American rivers.

Open waters and marshes of San Francisco Bay provide winter environment for hundreds of thousands of waterfowl and shorebirds. The former provide hunters with an estimated 135,000 man-days of their sport and both provide some 370,000 man-days of recreation to a growing number of bird watchers. Very rough estimates of the adult populations of these fish and wildlife have been made (Table 1). They serve principally to document the fact that the fish and wildlife resources depending on this environment consist of very large numbers of a wide variety of species.

We have expressed the value of this resource as man-days of recreation supported or quantities of a commercial product produced annually (Table 2). Total recreation days provided by the resource are now between 3.5 million and 5 million annually. To this must be added the 5.7 million pounds of salmon landed annually by the commercial fishery. Table 2 is as sound an estimate of the value of the fish and wildlife resource dependent upon the San Francisco Bay-Delta as can be made with existing information. We have found no sound rationale for further defining their true worth. While monetary values have been placed on fish and wildlife resources, agreement about how to do this is rare. All attempts fall far short of a realistic description of the value of these resources to either the individual or to society.

We estimate that in the year 2000, the recreational use of fish and wildlife depending upon the Bay-Delta environment will have tripled to become from 9 million to 15 million recreation days annually. These predictions are also listed in Table 2. The striped bass population will remain as the most valuable portion of this resource. With research, proper environmental control, and increased rate of exploitation, it will continue to provide more than half of the total recreation days. Shore and pier fishing is expected to become the second most important use of the resource as the human population density and public access to the bay increase. It will support from 15 to 30 percent of the total recreation days.

The increase in waterfowl hunting may not be great but the number of people who obtain value from merely seeing waterfowl and shorebirds in marsh and shoreline areas and the time they spend there is expected to at least double. More people will be seeking recreation by fishing for salmon in the ocean, for salmon and steelhead in the rivers above the Delta, for catfish and centrarchids in the sloughs of the eastern Delta, and for sturegon in the bay. Providing the contamination problem can be solved, 210,000 man-days per year will be spent digging clams and a commercial oyster industry may produce 1.7 million gallons of oysters.

Our prediction of the future use of these resources is based upon forecasts of increased human population, and two important assumptions:

Assumption 1: Poor water quality will not be the environmental control limiting fish and wildlife populations or their use.

Table 1

Estimates of the adult populations of certain
species of fish and wildlife dependent upon the
San Francisco Bay and Delta environment

Striped bass	2,500,000 to 8,000,000	
King salmon	1,000,000	
Steelhead	40,000 to 60,000	
American shad	2,000,000 to 4,000,000	
Sturgeon	9,000 to 16,000	(San Pablo Bay)
Soft-shell clams	16,000,000	(intertidal zone)
Littleneck clams	4,800,000	(intertidal zone)
Waterfowl	200,000 to 1,000,000	
Shore birds	100,000 to 400,000	

Table 2

Estimated and predicted use[1] of fish and wildlife resources of San Francisco Bay-Delta expressed as thousands of man-days of recreation[2]

	Year 1957	Year 2020
Striped bass	1,500 - 3,000	4,300 - 10,700
Bay pier and shore fishing	643	2,500
Waterfowl and shore birds	505	875 - 1,010
Catfish	448	695
Salmon	187	350
American shad	100	177
Steelhead	73	150
Sturgeon	6	50
Centrarchids	No estimate	32 - 125
Clams	Negligible	200
Total	3,462 - 4,962	9,330 - 16,150

---

[1] Assuming adequate water quality and the solution of water development and reclamation problems.

[2] Salmon also support a large commercial fishery. Landings attributed to those salmon spawned in the Sacramento-San Joaquin rivers drainage and depending upon the maintenance of proper environmental conditions in the San Francisco Bay-Delta now average 5.7 million pounds per year. Prediction has been made that they will increase to 8.5 million pounds in 2020.

This appears to be a reasonable assumption. The very existence of the State Bay-Delta Water Quality Control Program is good evidence of society's intention to protect water quality of this estuary from future deterioration and to examine all possible ways of correcting present problems.

Assumption 2: Major environmental problems posed by water development and reclamation will be avoided or solved.

This also appears to be a reasonable assumption. The problems created by water development and reclamation are largely water quality problems, and it seems unlikely that the first assumption will be met without also meeting the second. Significant progress has been made in recent years by development and selection of the Peripheral Canal water development plan and by the establishment of the San Francisco Bay Conservation and Development Commission to guide reclamation of the bay. Some major problems have not been solved, but it is apparent that our society intends to solve them.

Provided the above assumptions are met, the use of fish and wildlife depending on the San Francisco Bay and the Delta will about triple in the next 30 years.

Included in this statement and appended hereto is a report entitled, "Status Report on the Coastal Wetlands of Southern California." The report briefly describes the present knowledge of the wildlife values of these estuarine areas. In this case, "estuarine" is used in its broadest sense to include wetlands which may only open to tidal action intermittently.

Also appended is the "Report on Natural Resources of Morro Bay and Proposal for Comprehensive Area Plan." This report presents the fish and wildlife values of this relatively unspoiled estuary, however, as with all estuarine areas in California, documentation of these values is continuing.

Much of this information on value assessments provided above on San Francisco Bay and in the two appended reports generally applies to the entire estuarine resource of California. Documentation of estuarine resource values of other areas now being carried out by the Department will be made available to the public and interested agencies as it is completed.

A value not to be overlooked is attributable to the scarcity of estuarine habitat. Since much of this type of habitat has been altered in such a way as to destroy its value for fish and wildlife, the small amount remaining has assumed greatly increased value. An estimate given before the House Subcommittee on Fisheries and Wildlife Conservation during hearings on H.R. 25 in 1967 showed that nearly 70 percent of estuarine habitat in California has already been destroyed.

Further destruction will most certainly affect the ability of many fish and wildlife species dependent thereon to survive. Once this type of habitat has been altered by filling, dredging, etc., the loss is usually final, in that man's alterations of this environment are most often irreversible.

2. How have they (estuaries) been damaged by pollution and how much?

If used in its broadest sense, pollution could be interpreted to mean any act which lessens the value of the estuarine resource to a particular user; in this case the fish and wildlife resource dependent thereon.

The appended report "Status Report on the Coastal Wetlands of Southern California" gives estimates of the present effectiveness of certain wetland areas to support wildlife. In most instances these figures show that man's alterations of the environment has decreased the wildlife carrying capacities of these areas. Not included in this report are estuarine areas already completely developed into harbors, marinas, residential areas, etc. Examples of complete destruction of the natural environment include those habitats now occupied by Los Angeles Harbor, Harbor Park, San Pedro Harbor and Ballona Creek in Los Angeles County; Lower Newport Bay and Huntington Harbor in Orange County; and Mission Bay in San Diego County. These areas once supported many thousands of acres of marshland valuable to fish and wildlife. As previsouly pointed out, it has been estimated that nearly 70 percent of California's estuarine habitat has been destroyed.

The loss of habitat to pollution contamination in the San Francisco Bay and Delta is another prime example of environmental destruction and is summarized as follows:

a. Contamination:

(1) The existing shellfish resource available for recreational use (harvest) within the intertidal zone has been fairly well identified as to locations, species, and densities (abundance). Approximately 21 million adult softshell and Japanese littleneck clams have been located in accessible (wading) sites. High coliform counts make all of these unsafe for human consumption. If public health standards were met, these resources could support from 210,000 to 420,000 user-days annually -- perhaps even double both of those figures, if a limit of 50 clams was not required by each clam digger to make a successful day and the legal limit were reduced to 25.

(2) Large numbers of clams that could be harvested commercially also exist in the deeper waters of the Bay. This resource has been estimated at about 50 million clams or 1,400,000 pounds. The potential annual commercial harvest is calculated to be between 800,000 and 1,000,000 pounds. Present prices indicate such annual production would sell at the retail price of $600,000. Contamination currently prevents any commercial use. There is a demand for these clams as evidenced by the importation of the same species from Washington and Oregon. Annual shipments to California now total about 1,000,000 pounds, selling retail at from $.50 to 70 cents per pound.

(3) A commercial oyster fishery could materialize as a result of actions taken to permit public consumption of the existing clam resources. We have estimated that 1.7 million gallons of shucked oysters could be produced annually from the Bay. This would be a 20 percent increase in the total U. S. production of oysters. At present wholesale prices of ±$3 per gallon the 1.7 million would be worth $5.2 million. This is a reasonable biological potential. Actual production would be influenced by social and economic factors.

It is interesting to note that before 1900 some 10 to 15 million pounds of oysters were harvested annually from S. F. Bay. Today, of course, there is no oyster fishery.

b. Other Problems

(1) Commercial shrimp landings in the Bay were as high as 6.5 million pounds, but in 1965, landings totaled only 10,000 pounds.

(2) At one time the sea otter was abundant in S. F. Bay. Also, large kelp beds existed. Today there are no kelp beds and no sea otters.

(3) Each year in the spring there is usually a fish kill involving striped bass and other fishes in the Carquinez Strait. Pollution of some sort is the probable cause.

(4) Many fish (striped bass) frequently have "tainted" flesh and hence not fit for eating. While petroleum wastes are suspect, a study is underway to determine the exact cause.

In addition to actual loss of habitat by dredging, filling and pollution, secondary value losses of the estuarine environment are attributable to man's physical presence. The fact that a freeway, boat harbor or high-rise apartment occupies less than the whole of a particular estuary does not mean that the remainder can be entirely used by fish and wildlife. Man's activities certainly can decrease if not entirely eliminate, in many cases, the value of an estuarine area to wildlife.

3 and 4. What do you think the future of our coastal zone should be? What are the best uses of our estuaries?

The above two questions are closely related and therefore are treated together. There are many interests in exploiting or using in some manner, the estuarine resources of California. More often than not, the various types of exploitation and uses are in conflict with one another, especially as such uses affect the ecological balance of the estuarine environment.

The Department of Fish and Game presented, in a statement to the California Assembly Subcommittee on Conservation and Beaches in 1968, three precepts to guide use and development of California's shoreline. These precepts can also be specifically applied to guide the use and development of estuarine resources and are as follows:

a. Uses of California's estuarine resource should be restricted to those activities which require the estuaries' resources or environmental attributes and which cannot be carried on elsewhere.

b. The existing environmental qualities and amenities of each estuary area should be preserved and, whenever possible, those environmental qualities already lost should be renewed.

c. Proposed uses that would cause irreversible modification of the estuarine environment should be approached with extreme caution.

The strict application of these or similar precepts by planners in the coastal zone would guarantee the continuance of the ecological values of the estuarine resource. Future use planning of California's estuarine resource must certainly recognize its ecological values if fish and wildlife species dependent thereon are to survive.

5. What system of management--social, state and federal will best provide for development and protection of our estuarine resources?

The basis for any system of estuarine preservation must include planning which considers all interests of the people in the estuarine environment. A comprehensive area plan which encompasses not only the estuarine resource area itself but also the area within the influence of the resource, should be the basis for proper use and development of California's estuarine resource.

Such planning can be carried out at any level of government, the selection of which would depend upon the nature of governments having jurisdiction in the resource area.

The planning agency could be a county or city planning department having complete jurisdiction over the use and development of the estuarine resources in its area. or the planning agency could represent quite a complex cross section of governments, all having a planning interest in the resource area. An example of such an agency is the San Francisco Bay Conservation and Development Commission, which was established by the California Legislature to prepare and submit a plan for San Francisco Bay. The report to the Legislature recommends that a governmental agency be created to carry out the "Bay Plan." This plan does include the interests of all the people in the Bay area and in California. However, in this case any meaningful action to properly plan for the area had to be initiated by the State Legislature because of the many levels of governments involved.

Even though the governmental makeup at Morro Bay area was considerably less complex than that of San Francisco Bay, the people requested legislation to require State government to identify the resource values for Morro Bay and to recommend measures for its protection. The Morro Bay report recommended to the Legislature that a comprehensive area plan be developed for the Morro Bay area. Such a plan is now in process of being prepared by the County of San Luis Obispo with input from the California Department of Fish and Game among others.

On a statewide level, California has taken a big step forward in estuarine resource protection by virtue of legislation in 1967 establishing the California Advisory Commission on Marine and Coastal Resources and requiring the preparation of a "California Comprehensive Ocean Area Plan." The Resources Agency, among many other state and local agencies, will be a major contributor to this plan.

The State Legislature has also ordered the State Resources Agency to formulate a plan to provide for the conservation of waterways of the State possessed of extraordinary scenic, fishery, wildlife or outdoor recreation values. Waterways, as defined in the Act, are bays, estuaries, marshes, wetlands, lagoons, streams, channels, lakes and reservoirs.

The above planning actions, whether state or locally sponsored, reflect public concern over the estuarine resource of our State. We are optimistic that both San Francisco Bay and Delta and Morro Bay will have benefited greatly from legislative action requiring long-range planning.

There are other ecologically important estuarine areas in the state in need of long-range planning. State legislation requiring such planning for the estuarine resource applied uniformily throughout the state would be of great assistance in assuring that the best uses are made of these areas.

This Department, which has been involved in the formulation of comprehensive planning for San Francisco Bay and Morro Bay and will be a major contributor to the State's Comprehensive Ocean Area Plan and is now preparing fish and wildlife species plans together with the necessary documentation of fish and wildlife values for each estuarine area. These species plans will form a basis for recognizing the resource values by area planning agencies.

Once fish and wildlife plans have been prepared for an area, implementing such plans or incorporating them into area plans will be the responsibility of the local planning agency, be it a BCDC or a local governmental planning department. In addition to considering fish and wildlife values of the estuarine resource, each planning agency should be guided by the three precepts as previously outlined.

In addition to the area planning initiated at all levels of government, the following actions should also receive consideration as a means of estuarine resource management:

a. Establishment of a nationwide "Estuarine System" that protects important estuaries. States should be encouraged to develop their own Estuarine Protection Plans.

b. "Open Space" legislation for estuarine areas which would provide a tax break for private lands in high value areas. Guarantees should be required that land would remain undeveloped for a specified period.

c. Legislation at the State level which would stimulate local planning agencies to formulate comprehensive area plans for their estuarine areas. Such plans to provide adequate consideration for the natural resource values and subject to state review.

d. Legislation which would provide for Resources Agency review of any proposed dredging or filling operation affecting the estuarine resource with power of regulating such dredging and filling. Similar legislation has been effected by several eastern states with success.

e. Legislative provisions to acquire those lands in private ownership which have high ecological value or compensate the owner for imposing use limitations on his property.

Most important, however, are efforts which will make available to the public and planning agencies factual information from which decisions can be made that consider the total value of an estuarine area.

State of California
Resources Agency
Department of Fish and Game

STATUS REPORT ON THE COASTAL WETLANDS
OF SOUTHERN CALIFORNIA
AS OF
FEBRUARY 1, 1969

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STATUS REPORT ON THE COASTAL WETLANDS
OF SOUTHERN CALIFORNIA
AS OF
FEBRUARY 1, 1969

This report summarizes the Department's present knowledge of the ecological values, land ownership, and proposed plans for coastal wetland areas in southern California. The Department's current bay and estuary study and shorebird study as completed, will update the information presented here. The Department's present bay and estuary study program in southern California includes Goleta Slough, Pt. Mugu, Anaheim Bay, Upper Newport Bay and Los Penasquitos Lagoon. As studies on these areas are completed, other areas of high priority will be included in the program. However, the fact that an area is not now included in the study program does not preclude the Department from taking appropriate action to preserve the area's ecological integrity from an immediate threat. Reviews are made of proposed projects that may affect an estuarine area. Measures to protect and enhance the fish and wildlife resources within the project area are recommended.

In addition to the Department of Fish and Game, there are a number of other state and federal agencies concerned with the use and development of coastal wetlands and are carrying out various studies and investigations. In brief, they include:

1. Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior

   This Bureau has been assigned the responsibility of implementing the provisions of H. R. 25, the Estuarine Bill, which was enacted in 1968. The new law requires the Bureau to inventory and study the estuarine resource of the nation and recommend measures for its preservation. Congress has requested a report by January 1970. The Department of Fish and Game will be a major contributor of data concerning California to the Bureau's study.

2. Federal Water Pollution Control Administration

   A study of estuarine pollution is now being conducted by this agency. A report to Congress of FWPCA findings on estuarine pollution problems along with recommendations is to be submitted by November 1969. The Department of Fish and Game has provided much information for the FWPCA study.

3. California Department of Parks and Recreation

   Their long range plans call for acquisition of ecological areas to represent various natural environments throughout the State. This would include coastal wetlands. The Department is now in the process of classifying the entire coastaline into various types of beach. In addition a detailed land ownership of the coast is being prepared. The emphasis of this particular study is on recreation use areas of the beach. However, ecological data for all estuarine areas supplied by the Department of Fish and Game will be included in the coastline study report.

4. State Lands Division

The Division is responsible for administering the state-owned tide and submerged lands along California's coastline. Much of this type of land, valuable to fish and wildlife, has already been granted to local agencies for development. However, for those lands still in state ownership, the Division has recently requested various state agencies to list the types of uses that would be most damaging to the resource they are concerned with which are found on such lands. The Department of Fish and Game will request that all coastal wetland important to fish and wildlife be preserved in a natural condition.

5. Wildlife Conservation Board

The Wildlife Conservation Board has made previous surveys of coastal access (R. G. Sturges, 1957) and southern California lagoons (L. H. Carpelan, 1960).

The Board is actively interested as a capital outlay source in preserving key coastal wetlands for ecological reserves and public access and recreation by acquisition and limited development. They have state and federal funds at their command to accomplish this goal. The Board has state funds in the form of $750,000 annually from the state's share of pari-mutuel revenues derived from wagers on horseracing and federal funds from the Land and Water Conservation Act.

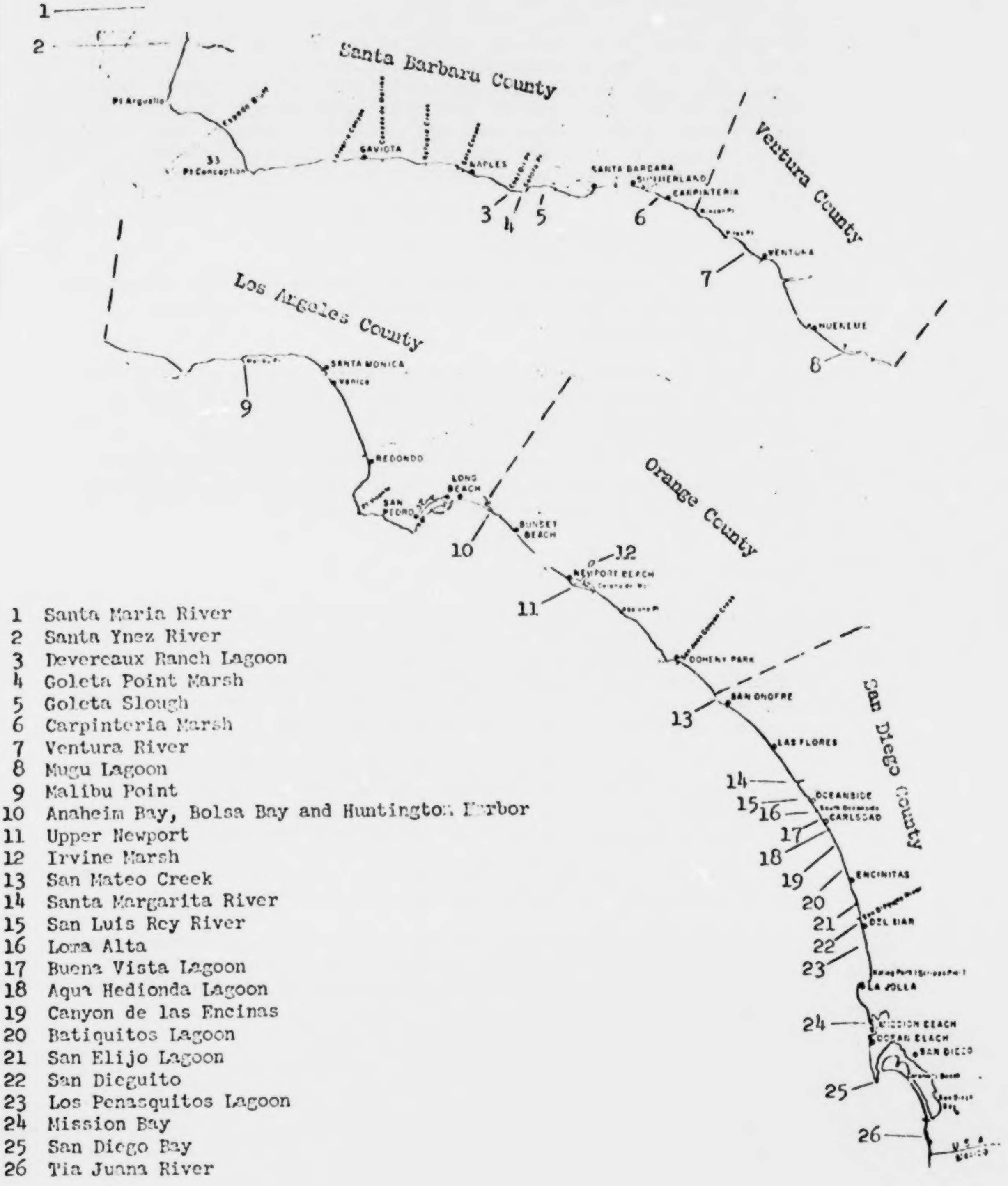
6. Resources Agency

As a result of Legislation in 1967, the Governor was given the task of preparing a Comprehensive Ocean Area Plan which will include the coastal wetlands resource. Development of the plan will be coordinated by ICOR (Interagency Council on Ocean Resources) and the Resources Agency will be a major contributor to the plan. No deadline has been set for the completion of the plan.

In 1968, the Protected Waterways Act assigned the Resources Agency the responsibility of identifying waterways in California having outstanding scenic, wildlife, fishery or recreational qualities and preparing a plan for the preservation of such waterways. Bays, estuaries, marshes and wetlands are defined as waterways in the Act. A report identifying such waterways and recommending means for their preservation is due to the legislature by January 8, 1971.

Following are brief summaries of each coastal wetland in Santa Barbara, Ventura, Los Angeles, Orange and San Diego counties. Those areas of lesser importance were treated in less detail and are grouped at the end under the heading, "Other Coastal Wetlands."

SOUTHERN CALIFORNIA COASTAL WETLANDS LOCATION MAP


Santa Barbara County
Ventura County
Los Angeles County
Orange County
San Diego County
Pt Arguello
Pt Conception
GAVIOTA
NAPLES
SANTA BARBARA
SUMMERLAND
CARPINTERIA
VENTURA
HUENEME
SANTA MONICA
Venice
REDONDO
SAN PEDRO
LONG BEACH
SUNSET BEACH
NEWPORT BEACH
DOHENY PARK
SAN ONOFRE
LAS FLORES
OCEANSIDE
CARLSBAD
ENCINITAS
DEL MAR
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MISSION BEACH
OCEAN BEACH
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1 Santa Maria River
2 Santa Ynez River
3 Devereaux Ranch Lagoon
4 Goleta Point Marsh
5 Goleta Slough
6 Carpinteria Marsh
7 Ventura River
8 Mugu Lagoon
9 Malibu Point
10 Anaheim Bay, Bolsa Bay and Huntington Harbor
11 Upper Newport
12 Irvine Marsh
13 San Mateo Creek
14 Santa Margarita River
15 San Luis Rey River
16 Loma Alta
17 Buena Vista Lagoon
18 Aqua Hedionda Lagoon
19 Canyon de las Encinas
20 Batiquitos Lagoon
21 San Elijo Lagoon
22 San Dieguito
23 Los Penasquitos Lagoon
24 Mission Bay
25 San Diego Bay
26 Tia Juana River

SANTA BARBARA COUNTY

Goleta Slough

The Area

Goleta Slough is located between the Santa Barbara County Airport and the Pacific Ocean and is almost totally owned by the City of Santa Barbara. The marsh area comprises about 250 acres. During the wet months, almost the entire area is flooded--the water backing up behind the sand spit at the mouth of the lagoon. Flood waters break the barrier each year allowing tidal action in the lower part of the lagoon. The upper half of the marsh is diked off and tide gates prevent tidal waters from entering this section. Therefore, this area becomes dry during the summer and remains so until the first fall rains. Mosquito abatement is the reason given for controlling the water.

Wildlife Values

Over 75 species of birds have been identified on Goleta Slough. Ducks and coots have been recorded in the highest numbers. Shorebird use is also substantial. It is estimated that the area receives about 450,000 bird days use annually. The major loss of marsh habitat can be attributed to construction (filling) of the airport. Because of the airport and other alterations of the marsh its effectiveness to support wildlife has been reduced by 50 percent.

Human Use

Hunting is not allowed on the marsh and there is very little fishing activity. The area's greatest potential is for nonappropriative uses such as birdwatching, photography and ecological (nature) study. Grammar schools, high schools, colleges and nature groups all utilize the natural values of the marsh. The University of California at Santa Barbara alone has 12 classes in the biology department which use the marsh as a natural laboratory. The members of the Audubon Society in Santa Barbara (250) make about 10 trips each year to the marsh. A number of high schools and grammar schools utilize the marsh in their biology studies.

Development Plans

1. Corps of Engineers original proposal to channelize the lagoon has been modified--the channel will end at the upper end of the marsh area.

2. City of Santa Barbara - The mayor has a plan for developing the slough into a recreation lake. The city council has not adopted this plan as yet. The city is also considering developing the area into a golf course.

3. Division of Highways - The Division has plans to extend the Ward Memorial Freeway to serve the University of California at Santa Barbara. The

right-of-way will cross the slough. The Department of Fish and Game has been negotiating with the Division of Highways to mitigate the loss of habitat.

Goleta Slough is one of the eleven high priority coastal wetlands areas included in the Department's estuarine study and planning program.

Carpinteria Marsh (El Estero)

The Area

Carpinteria Marsh is located 10 miles south of Santa Barbara, between the City of Carpinteria and the Pacific Ocean in Santa Barbara County. The estuary supports a 200-acres salt marsh. At low tide mud banks and flats are exposed, ideal for feeding shorebirds. The predominate vegetation is pickleweed with small amounts of alkali bulrush and cattail in the southeastern portion of the marsh, influenced by freshwater from Franklin Creek. The main channel is kept clear of sand and mud to allow tidal action and to permit flood flows to readily pass through the marsh.

The entire marsh is privately owned. One hundred and thirty-five acres is owned by the Title Insurance and Trust Company. The Company is composed of 10 landowners. Another 38 acres is owned by the Sandyland Protective Association, composed of a number of individuals. The members of the Company and the Association have formed their respective groups for the purpose of preserving the marsh in its present state as a buffer from urban encroachment.

Wildlife Values

In excess of 120 species of birds have been seen on the marsh. From November to May the marsh has received an estimated 170,000 bird days use. El Estero is one of the three remaining marshes of major importance in Santa Barbara and Ventura counties. The marsh area has not been appreciably altered by man to date and still remains virtually 100 percent effective in supporting wildlife.

Human Use

Very limited because the area is entirely privately owned and patrolled. The marsh now serves as a buffer against encroaching developments and provides privacy to the residential development along the shoreline.

Action to Preserve Area

The Department has been negotiating with some of the landowners who have considered deeding the land to the Department. However, before this can be accomplished all owners in the trust companies must agree to this action. As yet unanimous approval to such a proposal has not been obtained.

The county has recently developed an approved master plan which shows the Carpinteria Marsh area as a marina. If Department negotiations fail, it is likely that the area will eventually be developed in accordance with the county's plan.

This area was not included in the Department's estuarine study because of the ongoing negotiations to place the area in public ownership.

VENTURA COUNTY

Mugu Lagoon

The Area

Mugu Lagoon is located 17 miles south of Ventura and 50 miles north of Los Angeles and is within the boundary of the Point Mugu Naval Air Station. This federally owned area is one of the few true estuaries in California. Approximately 2,100 acres of the area can be classed as marsh, being subjected to varying degrees of tidal action. Of this acreage about 250 acres is inundated at all times comprising the deeper channels.

Wildlife Values

It is estimated that in excess of 120 species of birds are utilizing the marsh. More observations will have to be made to identify all the species which utilize this area and to determine bird days use. The effectiveness of this lagoon in supporting fish and wildlife has not been appreciably reduced. Most of the developments have been made on high ground. It is estimated that area retains about 80 percent of its wildlife supporting capability.

Human Use

The lagoon has been used by the Navy to study porpoises and sea lions. Also various universities, colleges and high schools have used the area for research and study of the estuarine environment.

Waterfowl hunting is permitted, but limited to base personnel, both military and civilian. Detailed regulations to control hunting on the base are issued each year.

Proposed Developments

The Division of Highways is planning to improve or realign Highway 101A. This improvement will probably involve lands within the marsh. Highways plans should be closely monitored.

Close liaison should also be maintained with the Navy to keep abreast of any plans they or others may have for the area.

Preservation Measures

The Department has prepared a Wildlife Management Plan for the base which states that the primary fish and wildlife objective is the preservation of the marsh habitat. If the lagoon is no longer of military use, every effort will be made to retain the area in public ownership.

ORANGE COUNTY

Anaheim Bay, Bolsa Bay, Huntington Harbor

The Area

This coastal wetland complex is located immediately southeast of Long Beach. Those areas now designated as Anaheim Bay, Bolsa Bay and Huntington Harbor were once part of a large estuary having its opening to the sea at the present location of Anaheim Bay. Huntington Harbor still is connected by channel to Anaheim Bay. However, a large part of Bolsa Bay has been cut off from the main channel by a road fill.

The complex contains about 5,000 acres of marsh and tidelands in various stages of alteration by man. Only about 2,800 acres exist in an unaltered condition. Marshlands within Huntington Harbor, for all practical purposes, have been completely destroyed by a marina and residential development. Marshlands in Bolsa Bay (Bolsa Chica) comprise about 1,200 to 1,500 acres and are crisscrossed by roads to the oil and gas wells dotting the area.

The main part of the unaltered marsh, Anaheim Bay, is contained within the Naval Weapons Station. Even though these lands are in federal ownership, their undeveloped status is not safe because of constant public pressure to displace the Navy.

Wildlife Values

Over 150 species of birds have been seen on the area. Of this number, about 100 species are seen regularly on the marsh. It is estimated that the area receives 720,000 duck days use annually, most of which occurs during the period mid-September to mid-March. Several hundred ducks are resident, utilizing the area year around. Shorebird use is greater than duck use. It is estimated that shorebird use is three million days use annually. The decrease in effectiveness of the area to support fish and wildlife is estimated to be 50 percent. Only a remnant of undisturbed marsh still exists. A 640-acre block of this marsh is on Navy property. However, the adopted freeway through the marsh and the Orange County marina will further reduce this to about half its present size.

Human Use

Use of the area is now mainly limited to nonappropriative users. However, at one time the area supported one of the finest and most exclusive waterfowl hunting clubs in the nation, but which eventually yielded to urban growth. Duck hunting continues on some of the marsh but is very limited. The area is also used by sport fishermen, but on a limited scale as the Navy is highly selective in granting fishing permits.

Planned Developments

The Orange County Department of Parks and Recreation has obtained a portion of Anaheim Bay from the Navy for development of a marina park now under construction. In addition there is continued public pressure for complete removal of the Navy base. The County Parks and Recreation Department is seeking another parcel from the Navy for development.

An adopted freeway route through the Anaheim marsh will further reduce its size and effectiveness for wildlife. However, the acreage to be filled for the freeway has not been calculated.

Huntington Harbor is being fully developed with bulkheads eliminating all marshland.

The southern portion of Bolsa Chica includes oil pumping operations which have preserved a portion of the marsh in a near natural condition. However, land developers are continuing in their attempts to obtain these lands. A Division of Highways map designates this area as "Proposed Bolsa Chica Marina."

Orange County has considered construction of an offshore marina in front of Bolsa Chica State Beach and at some point opening a channel into the Bolsa Chica marsh. This is part of a large complex involving Bolsa Island (artificial) for electrical power and desalting purposes, in addition to a causeway, expansion of state park parking facilities, etc.

Preservation Measures

This complex is one of the 11 priority areas selected for study by the Department. The fact that a part of the area is in federal ownership allows some time for completing a plan of action before the land status is apt to change. A fish and wildlife plan for the Navy base is now being prepared.

Upper Newport Bay

The Area

Newport and Upper Newport Bay are located within the greater Los Angeles metropolitan area in Orange County. The Upper portion of the bay is approximately 1,500 acres in size, the majority of which is open water. There are approximately 600 acres in marsh or tidelands. Several islands in the 3.5 mile-long channel comprise the majority of the marsh. Ownership of the Bay is divided between the Irvine Company and State Lands granted to Orange County.

Wildlife Values

Sample bird counts taken in January-February 1968 revealed a high of 37,000 birds on the area at one time. From the several counts taken during this period it is calculated that the area supports about $3\frac{1}{4}$ million birds during the period September to mid-March. Another one million bird days use is estimated for the remainder of the year bringing the annual total to $4\frac{1}{4}$ million bird days use. The Department has classified 82 species utilizing the area during a four-month period, however, it is thought that the species list would include as many species as listed for Anaheim Bay which number 158. The Upper Bay has remained relatively undeveloped, thereby maintaining most of its supporting value for fish and wildlife.

Human Use

Human use of the resources is limited to nonappropriative uses such as bird-watching and photography. Even though there is no legal access to much of the Bay shore, access over Irvine Company lands to the Upper Bay has not been denied. No quantitative assessment of use has been made by the Department.

Proposed Developments

The immediate threats to the Upper Bay are the planned developments by Orange County and the Irvine Company which will be made by a proposed exchange of lands between the County and the Irvine Company who own or control all land around and within the Bay.

The proposed developments will completely destroy the marsh and tidelands upon which numerous shorebirds are dependent upon for food and cover. Loss of this habitat will displace the shorebirds now living in Upper Newport Bay. The open water would still be utilized by waterfowl as a resting area, however, the total numbers of birds utilizing the Bay would be reduced to a fraction of the numbers now present. The clapper rail, now considered an endangered species would be displaced from another segment of its critical habitat.

Preservation Measures

Upper Newport Bay, including the Irvine or San Joaquin Marsh to the east of the Bay, is included in the Department's bay and estuary studies and planning program. Apparently at this time there is still a question regarding the finality of the land exchange. On this basis the Department is proceeding with its studies to document the fish and wildlife values of the Bay. There is also considerable local interest in preserving the Bay from University people and local conservation groups such as "Friends of Newport Bay."

The County in a hearing before the State Lands Commission has agreed to clear its plans for Upper Newport Bay with the Resources Agency.

Irvine Marsh

The Area

The marsh is located within the Newport Bay drainage in Orange County, approximately one-half mile easterly from the Newport back bay. It is approximately 150 acres in size and is composed of a series of open water ponds and a marsh. The marsh vegetation includes willows, baccharis, tree tobacco, cattail and tules. Annual flooding of the ponds by the duck club is the source of water. The land is owned by the Irvine Company.

Wildlife Values

The San Joaquin Marsh is one of the richest wildlife areas in Orange County. Fall and winter populations of waterfowl have included daily numbers of 5,000 to 10,000 ducks and 200 to 300 geese. The area supports at least 360,000 duck days use annually.

Many of the same species occurring on Newport Bay can also be observed on the San Joaquin Marsh. In addition to the water-associated species, pheasants, valley quail, rabbits, raccoons and deer live in the Marsh. Many bird species nest in the Marsh.

Human Use

The Marsh is presently operated by the San Joaquin Gun Club as a waterfowl hunting area, comprising the major use of the wildlife resource. Birdwatchers can observe the birdlife of the Marsh from its outer edges.

Development Plans

The Irvine planning staff has designated this area as a wildlife preserve. Soil tests show that the peat soils would be too costly to prepare prior to any building on the area. The company may be willing to sell the property as a wildlife area. The University has indicated an interest in administrating the Marsh as a natural area and is attempting to purchase it.

However, though no plans have been made public, the area could be easily dredged for an extension of Upper Newport Bay, an excellent site for a marina. This may be considered if the Irvine Company-Orange County land exchange in Newport Bay is consummated.

The area is included within the Upper Newport Bay study area of the Department's bay and estuary program.

SAN DIEGO COUNTY

San Mateo Creek

The Area

The last 2,000 feet of San Mateo Creek before it enters the ocean could be classed as a lagoon. It is located at the northerly boundary of Camp Pendleton and is now federally owned. The lagoon and marsh total about 125 acres most of which is densely vegetated with tules and willows. San Mateo Creek only flows intermittently during the rainy season. The sandbar at the mouth of the creek is rarely breached. Surfing conditions in this area are considered to be some of the best in California.

Wildlife Values

The Department has not made any bird counts in this area or otherwise documented the wildlife values. Because of the dense vegetation, the area would be quite valuable to the secretive shorebird species such as rails and gallinules. The area has been traversed by a railroad and a freeway which has reduced the original riparian habitat by about 20 percent to 25 percent.

Human Use

The area is within Camp Pendleton and has been used under a lease or permit by a surfing club.

Planned Developments

The Department of Parks and Recreation has planned a park for the entire lagoon and marsh area (San Onofre Project). A drawing dated December 3, 1968 shows the entire area east of the railroad tracks developed for camping and parking. The vegetation between the tracks and the ocean is shown as remaining undisturbed. The San Onofre project is budgeted for 1970-71. If the area is developed as shown on the preliminary general development plan, much of the area's value to wildlife will be destroyed.

Preservation Measures

The Department of Fish and Game has requested that the park plans be altered to protect and preserve a portion of the area for wildlife.

Santa Margarita River

The Area

This wetland area is located about two miles north of Oceanside on Camp Pendleton Marine Corps Base. The lagoon, freshwater ponds and marsh total about 800 acres, all of which is in federal ownership. The slough area extends inland from the ocean about one mile. Across its mouth, the lagoon is more than a mile wide. It is blocked from the ocean by a sandy beach which is breached only infrequently during flood flows in the Santa Margarita River. The lower portion of the wetland area has been used by the marines as a heavy equipment training ground. These maneuvers have eliminated the vegetation on about 300 acres of land located between the freeway and the ocean. Two sewage treatment plants serving portions of Camp Pendleton discharge secondary effluent directly into the lagoon, presently amounting to about 250,000 gallons per day; but this volume will be substantially reduced or eliminated in the future. A plan whereby effluent will be pumped upstream in the Santa Margarita River for ground water recharge, as part of the overall waste water reclamation program of Camp Pendleton, is being studied at the present time.

Wildlife Values

It has been roughly estimated that the coastal wetlands of the entire Marine Base supports about one million bird days use of all water-associated species. Most of this use would occur on the Santa Margarita River area. Bird counts have been scheduled to be made by the Audubon Society and other interested groups during the fall, winter and spring of 1968-69. The loss of vegetation on about 300 acres of coastal wetland has certainly decreased the ability of the area to support wildlife, however, the sewage effluent discharged into the lagoon has probably enhanced the original condition of the area as a whole by providing a stable source of water.

Human Use

Public use is restricted to surf-fishing by permission. If the area is developed for wildlife as proposed, overlooks for viewing the marsh and its birdlife will be provided for public use. The lagoon is presently visible to the public from Interstate Highway 5 and from the railroad.

Proposed Developments

The Department has prepared plans for improvement of the Santa Margarita wetlands, which have been included in Camp Pendleton's budget request. A major part of the plan calls for the rejuvination of the 300-acre area now denuded of vegetation. There are no known proposed plans to develop the area for purposes other than wildlife with the exception of possible construction of holding basins, upstream of the marsh for disposal of sewage effluent. There is, however, increasing local pressure to force the Navy to abandon its existing port alongside Oceanside Harbor and develop a new harbor at the Santa Margarita mouth. The city would then occupy the existing Navy port.

Preservation Measures

The Department has requested that Military Services preserve all coastal wetlands located on military lands. The Department has prepared a fish and wildlife plan for Camp Pendleton which included proposals for the preservation and enhancement of coastal wetlands.

Buena Vista Lagoon

The Area

The lagoon is located immediately north of the City of Carlsbad and about 33 miles north of San Diego in San Diego County. A 74-acre portion of the lagoon is owned by The Nature Conservancy with plans to lease it to the Department of Fish and Game. Possible acquisition of an additional 65 acres is being explored that would add to the 74-acre portion owned presently by The Nature Conservancy. The two parcels mentioned above are mostly open water. This is one of the few freshwater lagoons remaining on the Pacific Flyway. The water depth varies from a few inches to six feet. A few low islands and a minimum shoreline provide vegetation, feeding, nesting and resting areas for land and shorebirds. A sandbar forms an ocean beach across the mouth of the lagoon, breached only infrequently by high tides or floodwaters. The present water source consists of annual watershed runoff, and agricultural waste water. Additional sources of water may be needed to maintain the lagoon in dry years.

Wildlife Values

The wildlife values of the lagoon are nationally known and have been recorded in documents and literature over a period of years. Nearly 200 species of birds use its land and water environs. In 1950 a study for the Wildlife Conservation Board reported "concentrations of 60,000-70,000 ducks use the lagoon." Recent developments requiring the filling of the marsh lands in the upper part of the lagoon have to some extent decreased the wildlife-carrying capacity of the lagoon. It is estimated that the lagoon has lost about 25 percent of its original value for wildlife to commercial development.

Human Use

This is one of the foremost birding areas in southern California. Easy access from the freeway, bisecting the area has encouraged high use by passing tourists. The area is proposed to be designated as an Ecological Reserve. Regulations for ecological reserves limit use of such areas to nonappropriative uses except that fishing and scientific collecting by permit is allowed.

Planned Developments

The land presently in private ownership with the exception of the Palomar Savings and Loan propoerty, will eventually be developed (filled). A 35-acre parcel at the upper end of the lagoon has been offered for sale to conservation interests for an exorbitant price. The Department may, in the future, improve the wildlife capacity of the lagoon by constructing additional islands.

Batiquitos Lagoon

The Area

Batiquitos Lagoon is located in San Diego County about 27 miles north of San Diego and three miles south of Carlsbad. The lagoon is approximately 475 acres in size. The area can be classed as a seasonal marsh since most of it becomes dry in the summer. In appearance, the lagoon resembles a sterile salt flat for most of the year. When inundated, the lagoon resembles a lake, although its actual depth may be only a few inches. During the dry period, several ponds usually remain in the westerly end of the lagoon near the Pacific Coast Highway, Santa Fe Railway, and Interstate Highway 5, all of which traverse the section near the coast. The lagoon extends inland for about 14,000 feet and has a maximum width of 2,800 feet and an average width of 1,700 feet. The bar blocking the lagoon from direct tidal interchange is rarely breached; only the action of extreme high tides, storms, runoff or deliberate removal of sand by man results in outflows or inflow of water. The lagoon is privately owned, the major portion of which is owned by Metcalf Properties and the Rancho La Costa Corporation.

Wildlife Values

Very little data has been gathered to document the wildlife value of this area. However, it is reasonable to assume that this area would get considerable use during the winter months from migrating waterfowl and shorebirds. With few exceptions, the species recorded for Buena Vista Lagoon in San Diego County would also apply to Batiquitos Lagoon. The entire lagoon is still in a natural condition other than being traversed by a railroad and two highways.

Human Use

No use figures have been compiled for this area. The area, if preserved for wildlife, would serve public best as an area for birdwatching, photography and nature study rather than for consumptive uses.

Planned Developments

A multimillion dollar residential development is now under construction easterly of the lagoon and overlooking it. The Metcalf Properties at the seward end of the lagoon have been evaluated by a harbor enginerring consultant firm for possible development as a marina and residential complex. The engineering report made in 1963 points out that development of the area into a marina will be quite costly because of the necessity to raise or remove the old Highway 101 bridge to allow boats access to the sea.

As time elapses the demand for waterfront properties will make the proposed development feasible.

Preservation Measures

This area is not presently under study and planning by the Department but will be treated as studies are completed on other bays and estuaries.

San Elijo Lagoon

The Area

San Elijo Lagoon is located three miles north of Del Mar and 22 miles north of San Diego in San Diego County. The marsh and lagoon at the lower end of Escondido Creek is approximately 500 acres in size and extends inland about $2\frac{1}{2}$ miles. The marsh vegetation is supported by sewage discharge from Cardiff, Solano Beach and Escondido. In the near future Cardiff and Solano Beach will discharge their effluent into the ocean and Escondido plans to reclaim its effluent. The marsh cannot be maintained at its present size without the sewage discharges or other source of water. The mouth of the lagoon is normally blocked by a sandbar maintained by wave action. The bar is broken to permit drainage of the lagoon and tidal interchange only by extremely high tides, ocean storms, heavy or sustained runoff from inland sources or deliberately by man. Most recent openings have been as the result of planned breaching of the bar. The property of the lagoon is entirely in private ownership.

Wildlife Values

The upper end of the lagoon supports a duck club which is still active. A bird species list has been compiled by members of the Audubon Society and appears in a report "The Eutrophication of San Elijo Lagoon" published by the Resources Agency and San Diego Regional Water Quality Control Board. Periodic counts made on the area indicate that waterfowl and shorebirds utilize this area most heavily during the fall of the year. For complete documentation of the wildlife values of this area, more studies are needed. However, because of the large size of San Elijo Lagoon and the lush vegetation it supports, this area is one of the finest wildlife areas in San Diego County. Since San Elijo Lagoon has been virtually unaltered by man it still retains about 90 percent of its effectiveness to support wildlife.

Human Use

The lagoon and its wildlife are now enjoyed by nearby residents, beach visitors and the millions who traverse it via highway. Duck hunting is still enjoyed on a duck club at the upper end of the lagoon.

Planned Developments

The Cardiff Development Company of Newport Beach has planned a marina residential complex for the lagoon. The mitigate for wildlife losses, the Company has agreed to set aside one hald an acrea as a wildlife preserve. Apparently the existing marsh habitat now intensely used by waterfowl and shorebirds has been created artificially by sewage discharges of several communities into the lagoon. With or without the development of the area by the Cardiff Company, it has been determined that the lagoon would eventually lose its wildlife values when the sewage was no longer dumped into the lagoon.

Preservation Measures

Because of the artificial conditions of the lagoon and the pending plans for its development, this area has not been included in the Department's estuarine studies and planning program.

Los Penasquitos

The Area

Los Penasquitos Lagoon is located 1.5 miles south of Del Mar and about 17 miles north of San Diego in San Diego County. The acreage of the wetted portion of the lagoon has varied considerably in the last 10 years, dependent upon the sewage discharges and presence or absence of a barrier at the mouth. In 1958 the wetted portion was about 17 acres. In 1963 it had increased to about 36 acres, mainly due to increased sewage discharges. In 1968 the wetted area was calculated at 202 acres. This increase can be attributed primarily to the fact that the mouth of the lagoon is open permitting tidal action and secondarily to increased sewage discharges into the lagoon.

The major portion of the marsh including the mouth is owned by the State of California's Department of Parks and Recreation and is included in the Torrey Pines State Park. Another sizeable portion of the marsh which adjoins the State property is owned by the San Diego Gas and Electric Company.

Wildlife Values

Over 70 species of birds have been listed for the marsh. This list, as well as a detailed listing of all flora and fauna of the area is included in a "Report on the Biological and Ecological Relationships in Los Penasquitos Lagoon and Salt Marsh Area of the Torrey Pines State Reserve," by John S. Bradshaw of the University of San Diego. The report contains some of the best data on the fish and wildlife resource obtained for any estuarine area in California.

Since the mouth of the lagoon has been kept open to tidal action, the fish and wildlife values have probably increased over what they were 10 years ago because of the high increase in the wetted area.

Human Use

Since most of the area is within a State park, human use will be limited to nonappropriative uses, except fishing. Opportunity to view the wildlife resource in the lagoon far exceeds the present demand or actual use.

Planned Developments

There are three planned developments which could adversely affect the ecological values of the lagoon.

1. A new sewage system will dispose of all effluent in this area through the San Diego metropolitan sewage system which discharges at Point Loma. When the new system is completed the present system will be discontinued, ending the contribution of all effluent to the lagoon, and decreasing the wetted portion at the upper end.

2. Proposed Flood Control Project by Corps of Engineers - The project could bypass the natural runoff around the lagoon. This project combined with

the sewage outfall proposal could cutt off all inflowing fresh water causing a change in vegetative makeup of marsh and loss of the upper portion dependent upon fresh water.

3. Construction of Electric Generating Plant - The proposed plant may require the filling of a small portion of the marsh, but more important would discharge a sufficient quantity of warmed water to change the ecology of the marsh. Solutions to this problem are being considered.

Preservation Measures

Los Penasquitos Lagoon is included in the Department's estuarine study and planning program. In February 1968 a report on the ecology was prepared for the Department of Parks and Recreation by John S. Bradshaw of the University of San Diego. This report has added materially to man's knowledge of this lagoon. The Department, along with the Torrey Pines Wildlife Association, will make certain recommendations to the San Diego Gas and Electric Company to preserve the present ecology of the lagoon during construction and operation of the proposed electric generating plant. The Department will also have the opportunity to review the Corps plan and propose modifications to protect the lagoon.

San Diego Bay

The Area

Almost the entire tidal portion of the Bay is public ownership; federal, state and local. A very small portion is privately owned and will be developed into a residential marina complex known as Coronado Cays. The Navy and San Diego Port District own most of the tide and submerged lands in the Bay. The State owns two small parcels, one of which is leased to a salt company and the other leased to the Navy. Both leases run to the 1980's. Most of the lands within the bay, subject to tidal action, have been developed (filled) or will be filled in the near future. The only sizable area having existing or potential wildlife values, other than water surface, is located in the southern end of the Bay. This area is now ponded for salt production.

Wildlife Values

The wildlife values for San Diego Bay have not been documented by the Department. However, it is believed that bird counts have been made by the Audubon Society and an annual waterfowl count made by Fish and Wildlife Service personnel. Wildlife values could be considerably improved by converting some of the salt pond areas to marsh land.

A study completed recently by Monte N. Kirven of the Museum of Natural History, revealed the importance of South Bay as a nesting area for Elegant Terns. South Bay is one of only two known nesting sites of this species, the other being Raza Island in the Gulf of Mexico. South Bay is also inhabited by the Least Tern which is now on the rare and endangered species list.

Human Use

It is estimated that approximately 75 percent of the marsh surrounding the bay has been filled reducing the effectiveness of the bay to support wildlife by approximately 50 percent.

Appropriative use of the wildlife resource is limited to fishing. The major use of the bird species in the bay will be of a nonappropriative type including birdwatching and bird photography.

Planned Developments

The San Diego Port District, the major owner of tidelands in the bay, is almost finished with their planned filling of tidelands to create land in the bay. One of the remaining projects requiring fill is located at Chula Vista. However, before the fill can be made, a layer of mud will have to be removed. A project of this nature was accomplished in the past by dumping the mud into the Pacific Ocean, however, it proved quite costly. The Port District has proposed to transport the mud across the Bay to the southwest shore where a mudflat could be constructed. The Department favors this concept and is working with the District and the San Diego Museum of Natural History to design a mudflat for maximum shorebird use.

Private enterprise is proposing to develop certain areas within the salt ponds in cooperation with the private utility in an effort to grow certain marine organisms commercially using warm water from the existing power plant as appropriate.

Preservation Measures

The above mentioned cooperation with the Port District is the first effort to preserve or enhance the natural values of the Bay. The status of State property interest in the Bay should be examined. If possible, State property should be retained in State ownership and maintained in a natural condition.

Tia Juana River

The Area

The Tia Juana River estuary is located in the southwest corner of San Diego County, bounded on the south and west by the Mexico-United States border and the Pacific Ocean. The wetland area encompasses about 1,000 acres, one of the largest parcels of true estuarine habitat in southern California.

Ownership of the marsh is both public and private. The Navy's holdings at Ream Field and Border Field include some marshlands. The State also has title to some tidelands in the marsh, however, the extent of State ownership has not been determined. The combined State and federal ownership comprises only a small portion of the marsh--the majority is in private ownership.

The wetted area is maintained by natural runoff from the Tia Juana River drainage, sewage effluent and tidal flushing. This is one of the few marsh areas in southern California subject to continuous tidal action.

Wildlife Values

During the fall, winter and early spring months of 1967, members of the Audubon Society made bimonthly bird counts at established stations in the estuary. During the seven-month period a total of 9,447 ducks and 131,172 other birds were classified and counted. The area is one of the few tidal marshes left in California and as such represents an area of major importance to migrating waterfowl and shorebirds. The area as it presently exists has not been appreciably altered by man and still retains most of its wildlife values.

Human Use

A firearms closure prohibits hunting. Appropriative uses of the area are limited to fishing and bait collecting. Nonappropriative use opportunity exceeds present demand.

Planned Developments

A marina residential development is planned for a major portion of the marshlands including the mouth of the estuary which will be dredged out to allow boat access to the sea. In addition a land exchange between the Navy and the developer has been proposed. The Navy wants to trade beach frontage lands adjacent to Border Field for lands owned by the developer adjacent to Ream Field. The exchange would provide the Navy with a buffer around its Ream Field operation.

Preservation Measures

The Department has been negotiating with the developer and the City of Imperial Beach for off-site mitigation of wildlife values lost to the proposed development. The city would provide funds for enhancement of marshland on Navy property.

The State Department of Parks and Recreation has indicated that it is interested in obtaining the beach frontage along Border Field from the Navy for use as a State Park. This is the same area which the Navy proposed to exchange for lands adjacent to Ream Field.

OTHER COASTAL WETLANDS

Santa Barbara County

Santa Maria River

The River is located on the Santa Barbara/San Luis Obispo county line about 26 miles south of San Luis Obispo. The marsh area at the mouth of the River covers about 50 acres. The area is included in the Parks and Recreation "South Coastal Study." Plans for preserving the area must be coordinated with the Department of Parks and Recreation. Their plans for the area are scheduled for implementation in about five years (1974).

Santa Ynez River

Located on Vandenberg Air Force Base, the mouth of the River contains about 100 acres of marsh land. The mouth of the lagoon is opened seasonally during periods of high water in the river. The Department has drawn up a wildlife plan for the area on the base. The plan needs to be revised giving additional management plans for the marsh habitat on the base.

Devereaux Ranch Lagoon

This lagoon is located in the City of Santa Barbara and is the property of the University of California. Most of the marsh area has already been lost to urbanization. A portion of the lagoon is now being filled by the University. Even though the remaining area has been designated as a nature reserve, it would be well to bring to the attention of the Board of Regents the ecological importance of such areas.

Goleta Pt. Marsh

This area is also the property of the University of California. It is more of a small lagoon or lake than a marsh. Its vegetation is influenced by drainage water from the University more than from the sea. The area has been designated as a nature reserve by the University.

Ventura County

Mouth of Ventura River

The area, located adjacent to the Ventura County fairgrounds in Ventura, contains a small marsh and algoon totalling 10 acres. The mouth of the river including the lagoon and some marsh is now owned by the county. Also 17.5 acres of river bottom between the freeway and the county park are owned by the Division of Highways. The Department of Parks and Recreation has included the Highways land along with several parcels of oceanfront property in the 1968-69 budget for acquisition as a State park. The county property will remain in county ownership. The Corps of Engineers is planning a flood control project for the river. Close contact should be maintained with Parks and Recreation and the Corps to preserve the wildlife values of this area.

Los Angeles County

Malibu Pt.

The point at the end of Malibu Creek contains a couple of small lakes and some marsh about 15 acres in size. A portion of the point is owned by Parks and Recreation and another portion is pending acquisition. The two parcels in Parks ownership would include most of the important habitat at the mouth of the creek. Parks and Recreation has proposed to maintain its present wildlife values. However, a current Corps of Engineers study may recommend the lagoon as an ideal site for a small craft harbor. Close contact should be maintained with Parks and Recreation regarding their reaction to Corps proposals for the area.

San Diego County

San Dieguito (Del Mar)

The lagoon is located adjacent to the Del Mar Race Track. The marsh, most of which has already been filled, now totals about 150 acres. The area is privately owned. Sewage effluent plus seasonal runoff supports the marsh. The opportunity to protect the remaining wildlife values of this area is very limited because of the ownership status and planned developments.

Aqua Hedionda Lagoon

The lagoon is located between Buena Vista and Patiquitos Lagoons within the City of Carlsbad.. The privately owned lagoon contains about 340 acres, 90 of which is marshland. All of the submerged portion of the lagoon is owned by the San Diego Gas and Electric Company. Waterskiing is the primary use of the middle and upper parts of the lagoon. Recreational use of the outer basin is restricted to fishing from the shore. The area does not possess significant wildlife values primarily because it is a deep water lagoon with a relatively small amount of marsh.

San Luis Rey River

The River borders the City of Oceanside and still possesses about 30 acres of marsh near the mouth extending inland about one-half mile. Upstream, the river bottom contains good riparian habitat, the preservation of which has been included in a recent Corps of Engineers flood control project. A portion of the riparian vegetation will always be maintained by prescribed checkerboard clearing of vegetation.

A sandbar at the mouth of the river prevents interchange of tidals except when the bar is breached during high storm tides, flood flows or by man.

Loma Alta

Located immediately south of Oceanside, the 40-acre marsh area is situated in the creek bottom. The narrow mouth of the creek is permanently blocked by a sandbar, breached only during periods of substantial runoff. Periodically the City of Oceanside drains the slough into the ocean. Wildlife use has varied, increasing during wet years. The Corps of Engineers is studying this drainage for flood control needs.

Mission Bay

This area is fully developed as a residential and commercial marina complex. Most, if not all, wildlife values have been destroyed. Just how much was lost has not been determined but this will be important from historical standpoint. The bay was once a major black brant wintering area..

A flood control channel bordering the south edge of Mission Bay, formerly known as Cudahy Slough,is still providing excellent waterfowl and shorebird habitat in its present state. Black brant still congregate and feed where the channel meets the ocean. There is talk of clearing the vegetation from this channel to develop it for waterskiing. Any such change should be prevented.

Canyon de las Encinas

This small lagoon is located about four miles south of Carlsbad and 29 miles north of San Diego. The open water covers about 10 acres. The Corps of Engineers is studying its flood control needs. This area needs further investigation.

OTHER COASTAL WETLANDS

(Minimum Information Available)

Area	Acreage	County
Santa Clara River	60	Ventura
Colorado Lagoon	15	Los Angeles
Sweetwater	100	San Diego
Los Flores	60	San Diego
MaGrath Lake		Ventura
Ballona Creek	500	Los Angeles
Bixby Slough	200	Los Angeles
Dominguez Channel	100	Los Angeles
Santa Ana River	60	Orange
San Juan Creek		Orange

REPORT OF THE NATURAL RESOURCES OF MORRO BAY

AND

PROPOSAL FOR COMPREHENSIVE AREA PLAN

Requested by Senate Resolution No. 176 in the 1966 First
Extraordinary Session

December 1966

EDMUND G. BROWN
GOVERNOR OF CALIFORNIA

HUGO FISHER
ADMINISTRATOR
THE RESOURCES AGENCY

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THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME
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Morro Coast Audubon Society
Santa Barbara Chapter of the Sierra Club
Arroyo Grande Sportsmens Club
San Luis Obispo Sportsmens Club
Santa Lucia Sportsmens Club
California Department of Parks and Recreation
California Department of Conservation
California Department of Harbors and Watercraft
California Department of Water Resources
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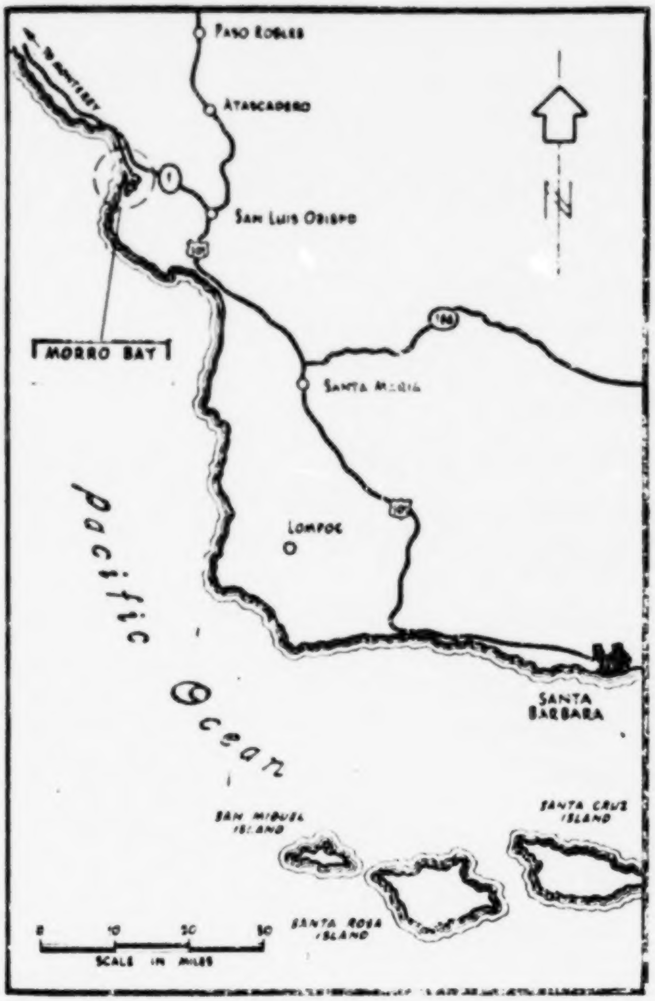
Paso Robles
To Monterey
Atascadero
1
San Luis Obispo
101
N
MORRO BAY
166
Santa Maria
Pacific Ocean
101
Lompoc
SANTA BARBARA
San Miguel Island
Santa Cruz Island
Santa Rosa Island
0
10
20
30
SCALE IN MILES

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State of California **The Resources Agency**

Memorandum

To : Honorable Hugo Fisher
Administrator of Resources
Resources Building
1416 Ninth Street
Sacramento, California 95814

Date: December 23, 1966

From : Department of Fish and Game - Deputy Director

Subject: Report of Natural Resources of Morro Bay and Proposal for Comprehensive Area Plan

Attached is the "Report of Natural Resources of Morro Bay and Proposal for Comprehensive Area Plan."

This report is for your consideration and further submission to the Secretary of the Senate in compliance with Senate Resolution No. 176 relating to the preservation of natural resources in Morro Bay and the surrounding area.

Deputy Director

Attach.

HUGO FISHER
ADMINISTRATOR

Department of Conservation
Department of Fish and Game
Department of Parks and Recreation
Department of Water Resources
State Reclamation Board
State Water Quality Control Board
State Water Rights Board
Regional Water Pollution
Control Boards

EDMUND G. BROWN
GOVERNOR OF
CALIFORNIA

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

OFFICE OF THE ADMINISTRATOR
RESOURCES BUILDING
1416 NINTH STREET

Honorable J. A. Beek
Secretary of the Senate
State Capitol Building
Sacramento, California 95814

Dear Mr. Beek:

In accordance with Senate Resolution No. 175 we respectfully submit the attached "Report of the Natural Resources of Morro Bay and Proposal for Comprehensive Area Plan."

Under separate cover we are sending 40 copies for distribution to the Senators.

Sincerely,

Administrator of Resources

Attach.

SENATE RESOLUTION NO. 176

Relative to the preservation of natural resources in Morro Bay and the surrounding area

(Introduced by Senator Fred S. Farr)

WHEREAS, Morro Bay and adjacent marsh areas are of utmost importance to the people of California because of the fish and wildlife which inhabit this region throughout the year; and

WHEREAS, The waters of Morro Bay and nearby areas are within the Pacific Flyway and are of the highest importance to preservation of migratory waterfowl populations; and

WHEREAS, Morro Bay is one of the few remaining locations in California which still provides habitat for black brant; and

WHEREAS, Nonmigratory waterfowl and shorebirds which inhabit the Morro Bay area are largely dependent on the nearby marshlands for survival; and

WHEREAS, The shallow water zones of Morro Bay provide areas for shellfish culture; and

WHEREAS, Morro Bay and nearby areas provide unique scenic attractions of great esthetic importance to visitors and residents of the area; and

WHEREAS, The preservation of these fish, wildlife, recreational and esthetic resources is of great importance to the people of California, now, therefore, be it

RESOLVED by the Senate of the State of California, That the Resources Agency is hereby requested to conduct a study of Morro Bay and the surrounding area and prepare a plan for the preservation of the natural resources therein, in cooperation with other agencies, organizations, and individuals, and to report to the Senate its findings and the plan on or before the fifth legislative day of the 1967 Regular Session of the Legislature; and be it further

RESOLVED, That the Secretary of the Senate is directed to transmit a copy of this resolution to the Resources Agency Administrator.

INTRODUCTION

The objectives of this report include:

1. Fulfillment of Senate Resolution No. 176.
2. Identification of the natural resource values to be considered in the development of Morro Bay.
3. Direct attention to the importance of initiating a comprehensive area plan involving all interests.
4. Suggest actions to develop and implement a comprehensive area plan.

Several planning studies and reports have been completed for Morro Bay. There are additional planning efforts underway at the present time. Each of these plans is directed toward one or several interests but none include all interests.

The Department of Harbors and Watercraft provided planning grant funds to San Luis Obispo County to study the feasibility of a harbor development in Morro Bay. One study, by Moffat and Nichols, Engineers, was completed in 1960 and a follow-up report was completed in 1962 by the same organization. The first report was preliminary in nature and demonstrated the harbor potential of Morro Bay. The follow-up study updated the first plan and evaluated the financing possibilities.

In addition, two studies have been completed by the San Luis Obispo County Planning Department: (1) Morro Bay Harbor General Plan, and (2) Baywood-Los Osos Area Master Plan.

The U. S. Army Corps of Engineers is in the second year of a three-year study to determine the feasibility of modifying the existing Federal project to provide for improved recreational boating and commercial fishing facilities.

The City of Morro Bay has initiated a planning study for harbor development in the north part of the Bay. Federal aid has been granted for planning to be used in part for the harbor plan. Planning consultants have been retained to accomplish this.

In each of these plans minor attention has been given to the natural beauty, scenic quality and natural resource values, although these are the basic values of the whole area. If they are not preserved for future generations, all other planning is futile.

SUMMARY

Morro Bay and its surrounding area contains natural resource values that are highly important, not only to the people of Morro Bay but to California and the nation. The Bay is truly unique and rare because nature has endowed it with a great variety of fish and wildlife. It is one of the few remaining unspoiled areas along the California coast that has not lost its natural endowment. Values closely associated with these natural resources include scenic beauty, diversified outdoor recreation, scientific and educational opportunity and other amenities of the ocean area.

Development plans that have been, or are being, prepared by various agencies do not give adequate attention to retention of these values. Conflicts of use have arisen that are causing concern among all interests. Any one use that is overdeveloped at the expense of the other uses may cause irreparable damage to the Bay environment.

This has all pointed up the need for a thorough and comprehensive area plan that will evaluate and consider all interests. The plan needs to be developed by a representative planning task force headed by San Luis Obispo County.

A decision-making body, such as a "Morro Bay Conservation and Development Commission" should be established to resolve conflicts that arise among proposed users and to assist with solving problems of the Planning Task Force. The planning group should be encouraged by legislative support and should have the full cooperation of all agencies and interests concerned. State assistance and Federal planning funds should be sought to carry out the planning effort. The plan should be developed and implemented as soon as possible.

RECOMMENDATIONS

Legislative

1. Authorize the organization of State and local groups to proceed with the orderly development of a comprehensive plan for Morro Bay.
2. Endorse the application of San Luis Obispo County to the State Office of Planning for Federal planning funds.
3. Establish a "Morro Bay Conservation and Development Commission", a decision-making body to resolve conflicts and ultimately adopt a comprehensive plan and submit it to the Legislature. Continue this group to facilitate maintenance of the plan.
4. Request that all State-owned tide and submerged lands within the Bay be held from disposal and remain in State ownership until a comprehensive plan is completed, after which all disposals will be made in conformance with the plan.

County of San Luis Obispo

1. Apply through the State Office of Planning for Federal planning funds.
2. Establish a Planning Task Force, including State and local representatives.
3. Seek public endorsement for planning objectives in the Morro Bay area.
4. Change the Planning Task Force to a Plan Maintenance Committee after completion of the basic plan.

Planning Task Force

1. Review, analyze and evaluate all existing single-purpose plans.
2. Delineate the planning area.

3. Develop a comprehensive plan for the uses of the Bay and its resources. This plan would provide for multiple use with maximum benefits and minimum costs.
4. Submit unresolved conflicts in uses and planning to the Morro Bay Conservation and Development Commission for decisions.
5. Submit the proposed comprehensive plan to interested parties for review and comment.
6. Submit the comprehensive plan for adoption to the Morro Bay Conservation and Development Commission.

Morro Bay Conservation and Development Commission

1. Make necessary decisions in plan development.
2. Submit the Morro Bay Comprehensive Area Plan to the Legislature for information and approval.
3. Rely on existing State, county and city organizations and the private sector for plan implementation.
4. Make plan maintenance decisions after the plan has been approved.

Plan Maintenance Committee

1. Provide staff assistance to the Morro Bay Conservation and Development Commission in evaluating plan modifications.

General Recommendations

1. All appropriate State and local authorities regulate debris and refuse disposal to protect water quality.
2. Acquire all private tidelands in the southern area of the Bay in public ownership to insure public access and resource protection.

PART I

RESOURCES

A. DESCRIPTION OF THE AREA

(See Appendix 1)

Morro Bay, a small scenic coastal bay in central San Luis Obispo County, is the only naturally landlocked harbor between San Francisco and San Diego. It is formed by the estuaries of Chorro Creek and Los Osos Creek, and is separated from Estero Bay by an elongated sand spit. Morro Rock, a volcanic plug, marks the entrance to the Bay.

Within this relatively small geographic area, almost every type of ocean shoreline is represented, and there are unique scenic natural features, outstanding wildlife attractions, and a variety of terrain.

Shoreline

The influencing ocean shoreline extends from Point Buchon north to Morro Rock and is extremely varied, from Point Buchon to Hazard Canyon it is primarily rocky, backed by steep bluffs. Unique features are the small pocket beaches and rock formations. From Hazard Canyon north to the tip of the sand spit, the shoreline is comprised of extensive sandy beach. The four miles of spit average $\frac{1}{4}$ mile in width and have extensive sand dunes with little vegetation. Morro Rock, the prominent landmark, is probably the largest offshore rock on the California coast.

Bay and Marshland

Morro Bay is entered through a narrow opening between Morro Rock and the sand spit. Breakwaters, a dredged channel, and harbor facilities which surround the entrance, have at this point altered the natural characteristics. The remaining bay shoreline is relatively untouched except for a small boat basin in Morro Bay State Park.

The tidal marshlands support a wide variety of grassy vegetation and bird life, all dependent upon the interaction of ocean water and fresh water flowing into the Bay through Chorro Creek and Los Osos Creek. At high tide, little land is visible· at low tide extensive mud flats are exposed.

Associated Upland

The upland surrounding the Bay, except for the sand spit, is gently sloping. Ancient marine terraces are evident, being more prominent south of Hazard Canyon.

Drainage

Chorro Creek and Los Osos Creek are the principal drainages of the watersheds emptying into Morro Bay. Though most of the watershed areas are not within the environmental limits, the impact of human use and development of those areas has been detrimental to the Bay ecology.

B. ECOLOGY

Morro Bay is a bay-estuary important to the fish and wildlife that are found in the area. The physical characteristics of associated channels, shallow waters, tidelands, and adjoining marshes and uplands make it unique and biologically productive.

The diversity of available water and surrounding land habitats attract large numbers and a variety of species of migratory wildlife and support many species of plants and fish.

Tidal areas and shallow waters perform an important function in assimilating wastes from both human and aquatic organisms. The Bay appears to have the capacity to assimilate the present loads; however, there are indications in recent studies that further commercial and recreational developments would heavily tax the capacity of the Bay.

Future development in and around the Bay must be given careful scrutinty, if the present quality and beneficial uses of the Bay are to be maintained.

C. HABITAT

(See Appendix 2)

There are about 2,000 surface acres of water in the Bay at high tide. At mean lower low water, about 1,400 acres of tidal flat are exposed. Eel grass, an important habitat for waterfowl, which also provides spawning and nursery areas for a number of fish, grows on the lower portions of this tidal area extending into deeper water. There are about 335 acres of eel grass in the Bay.

Salt marsh, of which there are about 575 acres, is also important to wild life. Marshlands support a wide variety of vegetation, most of it grasses.

Shallow waters are generally regarded as the most important part of any bay or estuary. This is where reproduction and growth of many marine plant and animal species take place.

Surrounding hills of chaparral and tree cover support upland game and many species of nongame wildlife. A few native Monterey cypress and Monterey pine dot the area in addition to those planted for major windbreaks. These trees, along with several kinds of eucalyptus, support a variety of resident and migratory bird life.

D. FISHERIES

The waters of the Bay are utilized for spawning and nursery purposes by California halibut, surf perch, and jack smelt, chiefly in areas associated with eel grass.

California halibut, starry flounder, sand sole, jack smelt, four species of perch, leopard and horned sharks, sting rays, and skates are the chief contributors to the sport fishery within the Bay.

Healthy populations of clams are located within the Bay. Gaper, geoduck, littleneck and Washington clams are the principal species. Their distribution is shown in Appendix 2. Pismo and razor clams are found along the ocean side of the Bay.

The Bay supports an oyster industry which depends upon the importation of oyster seed from Japan, and subsequent planting and growing in the productive shallow waters of the Bay. This activity has been curtailed recently due to a limited supply of oyster seed.

E. WILDLIFE

The primary species of wildlife using the Bay are the migrant water-associated birds. Greatest use is during the winter months. Eighty-nine species of birds have been recorded in and near the Bay during observations from 1950 to 1957. From these accounts, it is possible to get an idea of relative abundance and dominant species using the Bay.

Black brant, a valuable game bird, has been the subject of much more intensive surveillance. From 1931 to 1942, ground counts were made. From 1950 to the present, aerial counts have been taken.

Aerial counts are made during the hunting season. Hunting pressures cause wide variations in the numbers counted. The average number of birds counted is about 6,000. The largest number of brant counted since 1931 was 11,800 and the smallest number 1,190.

The eucalyptus trees at Fairbanks Point are the nesting sites for great blue herons and black-crowned night herons. These trees have been used by the herons for the last 16 years. About 60 pairs of great blue herons and about 25 pairs of black-crowned night herons use this grove for nesting.

Another nesting site is located in eucalyptus trees fringing the Bay north of the boat harbor at Cuesta-By-The-Sea. Approximately 50 nests are in use here. Black-crowned night herons are the dominant inhabitants. Great blue herons also use this grove.

F. LAND STATUS

(See Appendix 1)

Upland areas are mostly privately owned; however, there is substantial acreage in two parcels of land owned by the State of California Department of Parks and Recreation. These areas include a large section of bay frontage and provide ample beach access for public use.

Submerged and tidal areas are included in various grants-in-trust of lands made by the Legislature to local entities for specified purposes. There are three classifications of these lands existing in the Bay.

The State Lands Division indicates that neither the boundaries delineated for the tideland grants nor their location are well defined. They also point out that certain legal problems need to be resolved and surveys made before ownerships can be legally established.

Appendix 1 delineates the classification of bay lands. The northern-most portion includes the State's grant-in-trust to the County of San Luis Obispo. This is a grant which has subsequently been taken over by the City of Morro Bay.

Of the several plans and studies that have been prepared in recent years, the one for the northern grant embraces the most intensive developments These proposals include: (1) improvements of the harbor entrance and bay channel, (2) provision for commercial and recreation-oriented facilities, such as a convention center, to be built on the northern-most point of the sand spit, and (3) encouragement of tourism as a primary source of income and development of the Embarcadero lease site area to attract the maximum number of visitors.

Proceeding southward from the line of the city grant is an area which the State claims to be ungranted tide and submerged lands, out of which two parcels were patented into private ownership in the vicinity of the State park. These two parcels are roughly outlined on the map and identified as Tide Land Survey No. 2, which contains some 252 acres, and Tide Land Survey No. 13, containing approximately 38 acres. Both of these parcels were sold in 1872.

South of the ungranted tide and submerged area is the third classification comprising two parcels at the south end of the Bay which were sold in the early 1900's. They are noted on Appendix 1 as Tide and Location No. 131 and Tide and Location No. 220, comprising 538 acres and 28 acres, respectively. Even though it has been sold into private ownership, those areas below low tide are still subject to State claim since they constitute submerged lands which, by the Constitution, may not be alienated.

These submerged and tidal lands are part of the rich productive shallow water environment, and most of them should be retained for their ecological values. Citizens of Baywood Park and surrounding areas feel the need for a boat launching ramp which could be located in this general area. Some long-range plans project the demand for a substantial number of boat berthing facilities.

G. HARBOR

Governmental development and maintenance costs for Morro Bay during the last few years exceed $7 million. There are, however, additional improvements needed if the projected boating demands for additional protection, berthing and open water are to be met.

The present entrance is essentially unprotected from wave action at the entrance and in the entrance channel. Improvements would provide greater protection to boaters on entering and leaving the harbor.

Enlargement of the navigation channel in the city-owned portion of the Bay is also planned to relieve boat traffic congestion. This change will reduce tidal currents but will also increase tidal range in the south bay.

Some additional channel realignment is also planned. In the northern city-owned portion the channel will be shifted away from the waterfront toward the sand spit. This will provide additional areas for berthing and sea walls will be placed on the sand spit side to stabilize the channel.

Some channel changes are also being considered through the State-owned portion of the Bay to improve navigation access to the south end of the Bay. Additional channeling is also being planned through this portion to provide more boating and sailing areas.

Several exposed sand spit areas are subject to continuous wind erosion. These areas may require barriers to control the amount of shoaling in natural and dredged channels. Every effort should be made to provide natural barriers, such as plants, instead of fence-type structures.

PART II

USES

A. STATE PARK

(See Appendix 1)

Morro Bay State Park

Morro Bay State Park, acquired in 1934, contains 1,477 acres of which more than half is located on the sand spit. Morro Rock is also part of the State Park. This park provides 125 family campsites, a boat harbor, 25 family picnic units, two organizational camp areas, an 18-hole golf course, wildlife refuge and a Museum of Natural History. Attendance for 1965 was estimated to be over 900,000 persons. Lack of potable water has delayed full development of this unit, which could accommodate up to 600 family campsites.

The Museum of Natural History on White Point features birds and other types of natural resource life found in the area. The museum recorded an average of 1,200 weekly visitors, including 20 organized nature groups coming from as far away as Los Angeles, from June 15 to immediately after Labor Day, 1965. These groups also included visits on or around the Bay observing the natural resources.

Montana de Oro State Park

This park, in the process of acquisition, is located south of Morro Bay. Of the 7,525 acres authorized, 4,477 acres have been acquired. The remaining land to be acquired will place additional shoreline in public ownership and will connect this park with Morro Bay State Park at the south end of Morro Bay.

Montana de Oro State Park has only a few temporary facilities, inasmuch as the first acquisition occurred in 1965. Total park development is expected to provide nearly 1,200 family campsites, 500 picnic units, 5 group or organizational use areas, a marine reserve or study area, extensive riding or hiking trails and interpretive facilities. Annual attendance at full development is expected to exceed 2,000,000 visitors. These visitors can be expected to also make considerable recreational use of Morro Bay itself.

A principal objective in the land use planning for these two State parks is the preservation of large areas of natural landscape. This preservation is necessary to protect the scenic environment and wildlife habitat which are considered the principal attractions to the area.

B. SPORT FISHERY

A 1958 survey reported 18 party boats and 3,858 anglers taking 371,000 pounds of fish (341,000 pounds of rockfish). The 1966 estimate is a 50 percent increase.

Depending upon harbor development, a further increase is likely.

Skiff sport fishing in 1959 amounted to 2,387 angler days. This rose to 3,600 in 1964 (included in the skiff fishery is a small commercial fishery for leopard sharks). Shore fishermen expend approximately 5,000 angler days annually. Pier fishermen ran up a total of 8,000 angler days during 1958, using about 650 lineal feet of available space. Angling use annually is 16,600 man days.

Clam digging accounts for 1,500 days annually.

C. HUNTING

It has been estimated that 15 hunters per day used the Bay during the 1957-58 and 1958-59 hunting seasons. Estimates during the 1965-66 season indicate little or no change from these figures. This amounts to 1,875 hunter days in 1957-58 and 1,695 hunter days in 1958-59. The estimated total kill of black brant was 1,860 for the 1957-58 season. No estimate could be found of duck kill, but in all probability it would at least equal the brant kill.

Of significance is the fact that this is the only area, for quite a distance in any direction, where the public is allowed to hunt waterfowl. The nearest important brant hunting area is in Marin County bays, about 200 airline miles north. The nearest opportunity for duck hunting is about 90 airline miles east at Kern National Wildlife Refuge.

Hunting has proven compatible in multiple-use areas. Designated areas and time of use, however, may be needed if high concentrations of other uses develop in places now used for waterfowl shooting.

D. SCIENTIFIC AND EDUCATIONAL

There are considerable biologic, botanic, geologic, and wildlife resources of scientific and scenic interest.

This area has long been noted for its abundance of bird life. Lesser known, but also important, are some of the plant communities. The geology of the region is well exposed. Wildlife habitat, particularly waterfowl habitat, is of international concern. An underwater marine reserve also has been proposed for the area.

The Museum of Natural History, provided by the Division of Beaches and Parks, is one of five provided within the State and was located here because of the existing abundant resources. In addition, the San Luis Obispo campus of California State Polytechnic College is nearby and has a vital interest in preservation and interpretation of the natural phenomenon.

The area is also used by other educational institutions as well as individuals.

E. BOATING

There is little specific data on boating use in Morro Bay.

The Department of Harbors and Watercraft reports that 2,500 boats were registered for San Luis Obispo County in 1965 and 2,300 in 1964.

There are two public boat launching facilities in the Bay; one is located in the Morro Bay State Park and the other is located at the southwest end of the City of Morro Bay. The boat ramp in the State Park is operated by a concessionaire.

The city facility was constructed by the Wildlife Conservation Board in 1962 and is maintained and operated by the city. Reports indicate there were 16,200 man days' use of the city-operated facility in 1965.

Further development of recreational boating facilities is being planned in the city-owned portion of the Bay where limited facilities are already being used to capacity.

Projections for small boat berthing needs in Morro Bay are somewhere between 1,000 and 2,000.

The projected trailer-boat usage of San Luis Obispo County by 1975 is 12,500. A considerable portion of this projected use will be on Morro Bay.

Additional facilities for launching will be required and are also being considered for the south end of the Bay.

While some additional boating use is justified, care should be exercised that this use does not displace greater long-range values that may be more important than additional boat stalls or expanded boat operating waters.

F. URBAN

(See Appendix 1)

Three communities front on Morro Bay. The City of Morro Bay has modified its bay shoreline almost in its entirety with harbor developments. The other bayshore communities, Baywood Park and Cuesta-By-The-Sea, occupy prominent sloping beaches on the south shore and have not encroached to any great degree in the marshlands.

The present human population figures indicate there are about 10,000 people residing in the City of Morro Bay that was incorporated in July of 1964. The two unincorporated communities of Baywood Park and Cuesta-By-The Sea have an estimated population of 4,000.

It is expected that by 1980 the population around Morro Bay will increase to 23,000.

Commercial and sport fishing, tourism and a retired population provide the main business in the Morro Bay area.

G. INDUSTRY

Commercial Fishery

The Bay is a base for many fisheries. In 1964 the following amount (and value) of several species were landed.

Species	Weight (pounds)	Value (Dollars)
Albacore	3,800,000	$525,000
Jack mackerel	3,400,000	67,000
Pacific oysters (meat)	243,000	43,000
Salmon	39,000	21,000
Sardines	565,000	16,000
Surf Perch	25,000	5,500
All other species	314,000	25,000
Sub Totals	8,386,000	$702,500

In addition, the bottom trawl fishery in 1965 added the following:

Species	Weight (pounds)	Value (dollars)
Rockfish	900,000	$ 49,500
Petrale sole	150,000	19,500
Dover sole	150,000	9,000
Animal food (Hake, sablefish, small rockfish, etc.)	360,000	7,200
Sub Totals	1,560,000	$ 85,200
Totals	9,946,000	$787,700

Four or five vessels operate in the trawl fishery. There are two fish processing plants in Morro Bay, and significant quantities are trucked to a Santa Barbara processing plant.

Landings will presumably follow the general increase in human population unless increased marketing effort or change in consumer preference result in increased product demand.

The abalone fishery is a distinct industry. There are seven processing plants in Morro Bay. Red abalone is the chief species processed. The product is sliced, pounded and frozen.

In 1965 there were 71 abalone boats registered; in 1960 there were 66. In 1966 only about 45 or 50 of this number are operating. In December, 1966, 37 are operating.

Abalone landings in 1964 were 1,100,000 pounds valued at $264,000. In 1965, 1,279,000 pounds were landed at a value of $358,000. In 1966 landings are about the same. It is unlikely that there will be any significant increase in commercial harvest of abalone in this area. There have been proposals to change laws now limiting commercial divers to waters deeper than 20 feet. This could result in an increased commercial harvest but may conflict with sport use. Some proposals have been made by industry to cultivate abalone artificially. This could increase production.

One and one-tenth to one and six-tenths million pounds (in the shell) of giant Pacific oysters are produced annually. This represents about 11 percent of the State's output of oysters. In 1964, 2,400 cases of oyster seed were planted; and in 1965, 1,200 cases were planted.

The Bay contains 11 oyster allotments totaling 958 acres, as outlined in Appendix 4. Essentially all of the land which is satisfactory for conventional oyster production has been allotted. Newer techniques have been proposed using culture trays hanging from racks or rafts which would be in deeper water, at least 2 to 4 feet at low tide, and conceivably could be located in about 100 acres of water now unsuitable for clamming or oyster culture. This could conflict with esthetic, navigational or recreational uses.

An oyster (or shellfish) allotment is an area of State water bottoms granted by the Fish and Game Commission to an individual wishing exclusive privileges of cultivating shellfish upon such lands.

The absolute right to regulate, control, establish, provide for and dispose of oyster beds on the city-county submerged lands is reserved to the people of the State.

Allotments are granted 90 days following publication of notice in newspapers of general circulation in the county concerned.

The applicant is responsible for obtaining determination from the State Lands Commission that there is no infringment upon private water bottoms or water bottoms owned by or under the jurisdiction of any city or county.

Laws covering the cultivation of shellfish call for a shellfish cultivator's license, the rent of allotments at the rate of $1/acre/year, and the payment of a tax of one cent per packed gallon of shucked shellfish.

There is a small market crab fishery. Seven vessels in 1964 and 1965 reported 3,500 pounds landed that were worth $1,490.

Other Industry

As previously pointed out, Morro Bay industry is built around the commercial and sport fishery, tourism, and a retired community.

There is some shipbuilding in the Bay, and there are industries associated with boat maintenance and repair, supplies and services.

H. ESTHETIC AND SCENIC

The principal objective in land use planning for these State parks is the preservation of the large areas of natural landscape (including the Bay). This preservation is necessary to protect the scenic environment, wildlife and wildlife habitat which are the principal attractions of the area.

The scenic qualities of the Bay area and the sensitivity of the ecology are such that minor alterations may have major repercussions. This uniqueness makes the area attractive and wanted for its natural contributions. It is reasonable to believe that public demands for this kind of use will become greater and greater as other natural areas are changed by developments.

I. OTHER

The water-associated area is used importantly by wildlife for refuge, resting and feeding.

Eel grass is the principal food of the black brant. Thirty-eight brant gizzards collected in 1953-54 contained only eel grass. In studies on Humboldt Bay, it was found that the widgeon's main diet also was eel grass. Since eel grass remains thick and green throughout the winter, it also offers a year-around cover for fish and small marine animals.

In areas where eel grass has been depleted, it is difficult to re-establish. Every effort must be made to protect this important marine food and cover plant.

Animal life is the main food for many birds. Herons and egrets, for instance, capture free-moving animals such as fish in shallow water. Some ducks dive for a variety of invertebrates in deep water. Pelicans and terns make spectacular dives for their food which they capture in open water. The exposed tidal flats are the principal feeding areas for the small wading birds which probe for their food.

Food habits studies in Humboldt Bay and in San Francisco Bay have shown that mollusks make up 60 to 90 percent of the items eaten by diving ducks. Similarly, shorebird food diets in San Francisco Bay were found to consist of 30 to 60 percent mollusks with insects contributing 17 to 25 percent.

The salt marsh provides feeding and resting areas at high tide. Many of the small waders can be found resting in the extensive stands of pickleweed. Black brant have also been observed grazing here. These kinds of uses are heavy at times.

Another principal use is "birdwatching." An undetermined number of people participate in the activity of identifying and counting the various species of birds. Field trips to Morro Bay are scheduled frequently by organized Audubon Society groups. These groups come to Morro Bay from throughout the State for the purpose of bird identification.

There are a number of incidental uses that should be recorded because they exemplify the multiple-use values and further document the importance of the area to all facets of the population.

Other uses include hiking, building and riding dune buggies (vehicles built for use on sandy beaches and spits), and painting. There have been as many as 42 artists around the Bay at one time. This interest is further substantiated by the count of six art galleries in the town of Morro Bay.

All these uses are depend nt on the biological and geological nature of the areas.

PART III

CONFLICTS IN USE

Introduction

In the preparation of this report, various areas of conflict have been identified. These conflicts have become apparent during the preliminary search for information and programming. They represent only a few problem areas of a broad and general nature. A more comprehensive and detailed investigation will further identify conflicts of use and development.

1. The future of Morro Bay depends to a large extent on the objectives established to guide the pattern of use on and around the Bay. Presently, there are four or five single-purpose plans prepared or being prepared, all of which have different goals directing courses of action; none can be considered comprehensive. Conflicts of use and destruction of our natural resources will result without a comprehensive plan and cooperative course of action.

2. The fishery includes interests of clamming, oyster culture. commercial fishing from boats, and sport fishing on and around the Bay. Here, there appear to be several areas of possible conflict, such as commercial development on clam beds, oyster culture structures in or near boat channels, and excessive boat use of shallow waters.

The commercial fishery may conflict with boating, scenic, esthetic, educational, ecological and biological interests.

3. Industrial, commercial and harbor developments, if allowed without direction of comprehensive planning, may result in loss of some primary values which will not be replaceable.

4. Hunting is one use that may conflict with nonhunting use. Where projected uses are high, additional planning and programming may be needed.

5. Urban developments on the upland areas, particularly in the south Bay area, can be a detriment to the Bay environment if proper waste discharges are not planned.

While salt water intrusion is not generally recognized as a degradation of the marshland ecosystem, there are some domestic areas of concern. Salt water intrusion of the Chorro and Los Osos creeks' ground water basins might develop some real problems in the areas of domestic water supply.

Erosion control is also of primary concern. Conflicts with the biological and ecological status will occur if soil movement from building sites and subdivisions on uplands is allowed to continue.

Chorro Creek and Los Osos Creek have 25 and 8 miles of steelhead habitat. This represents about 14 percent of the total steelhead habitat available in San Luis Obispo County.

Clean runoff from upland areas to the Bay is needed to maintain the migratory fish runs and to control silt deposition in the Bay.

6. Boating is an important part of the comprehensive plan. At low tide, Morro Bay has a surface of only 600 acres. Thus, considering the Bay is mostly shallow water, there is little room for open water boat use.

Direct conflicts of use will occur if any structures are permitted on the water surface in areas deep enough for boating. If additional access boat channels are needed, care must be exercised not to destroy the important shallow water environments that are important to the biological productivity of the area.

7. The causes of changes, such as tidal, current, siltation, pollution and dirt fills, in the Bay ecology stem from increasing human use and

development of local resources without recognition of long-term impact or benefit of coordinated long-range planning.

The uniqueness of the Bay area and the sensitive ecology are such that minor alterations can have major repercussions. Abuse of the resource will result in irrevocable loss.

PART IV

DEVELOPMENT AND IMPLEMENTATION OF A COMPREHENSIVE AREA PLAN

A. Planning Method

Introduction

A great many uses are presently being made of Morro Bay and its resources. Additional new uses will be proposed as demands are identified or as technology makes them feasible. Most current uses are unplanned or have been planned with narrow objectives and for single interests.

As the number of uses and their individual size increase, conflicts arise, impeding some uses or wasting resources. These problems of conflict can be solved by the development of a comprehensive area use plan that considers the benefits and costs of each use and then combines them for maximum net benefits and minimum costs.

The objective of this chapter is to propose a method for developing a comprehensive plan for the use of Morro Bay. Such a plan is essential to protect the natural resources of the area, including the environmental amenities and to sustain its economy.

Procedure for Developing a Comprehensive Area Use Plan

The basic steps in developing a comprehensive plan for the use of an area are:

1. Delineate the area boundary.
2. Establish the objectives of the people in respect to the area.
3. Determine present and proposed uses.

4. Develop a plan to regulate the uses for maximum net benefits at minimum costs.

Morro Bay Area

The total area that should be included in the Morro Bay plan has not been defined. It should include not only the Bay itself, but the surrounding drainage basin, which must be properly used to prevent erosion and siltation; the scenic area, which nearly corresponds to the drainage basin; and the ocean shoreline. Roughly speaking, the planning area should extend from Point Buchon, in the south, to the beaches north of Morro Rock and extend inland a sufficient distance to include the previously defined features.

Objectives

The following objectives are proposed for the Morro Bay plan. The broad objective of this plan is to provide for the use of Morro Bay area and its natural resources now and in the future for the enjoyment and economic benefit of the people. More specifically, the plan will have the following objectives:

1. To maintain all the natural resources of the Morro Bay area for their intrinsic and ecological values.

The objective, "to maintain." is a basic necessity if any natural resource is to be used in the future. The "ecology" of Morro Bay is intricate, making it dangerous to tamper with any part of it without fully understanding the eventual result. Man has the obligation to pass on to future generations nature's renewable resources.

2. To maintain the environmental quality and amenity of the ocean area.

The second objective, "environmental quality and amenity," proposes that, along with the progress toward optimum development of the area, a high quality human environment be maintained. All of the factors that act on the senses of men such as scenic beauty, open space, and clean air are a significant part of this environment and are to be preserved for the visitor as well as for area residents.

3. To provide for the economic, recreational, and scientific use of the living resources.

The third objective, "economic, recreational, and scientific use," covers all the uses that will be made of the living resources of the area. These are the renewable resources that, if wisely used, can continue indefinitely. The state of complete development for any segment of this resource will be reached when the maximum sustainable yield is obtained. The total allowable use may be divided among the three types of use.

4. To provide for the economic, recreational, and scientific use of the area.

The fourth objective, "use of the Morro Bay area," covers the three types of use but is not directly related to its natural resources. Uses such as boating, commercial and industrial development, etc., may not depend directly upon consumptive use of the resources of the area. They do, however, require space both on the Bay and on the shore. These uses may conflict with other uses or may affect the Bay environment.

Precepts

1. The plan will provide for multiple uses of the Bay area and its resources.

It is quite possible for many uses to be made of the area. High density uses should not be allowed to completely crowd out low density uses. The uses should be related to the demand for their product, and as many different demands as possible should be satisfied. No use should unduly restrict another.

2. Renewable resources should be utilized on a sustained yield basis.

Renewable resources can last indefinitely if the rate of use does not exceed the rate of regeneration. There is no purpose in attaining the maximum allowable yield until there is a demand for that amount of product, but the maximum sustainable yield should not be exceeded no matter how great the demand.

3. Uses that cause irreversible modifications of the environment require intense scrutiny.

It is often extremely difficult to forecast the results of a change to the environment. Proposals that will make irreversible environmental changes must therefore be thoroughly investigated and weighed. Alternate methods of attaining the objective should be sought. There must be an assessment of the benefits that would accrue compared with the costs of a development and the segments of the population that would be affected by the costs. Mitigation for the loss of public resources should be the burden of those causing the loss.

4. Preservation, conservation and renewal of environmental quality and amenity should be sought.

No use of the Bay area or its natural resources should result in a lowering of environmental quality and amenity without replacement in kind or better. Physical changes should be made in such a way that the environmental quality and amenity remains equal or is improved both at the point of change and in areas beyond.

5. Uses of the Morro Bay area should be restricted primarily to those types that are dependent on the area's resources and environment.

Projected demands for activities that can only be carried on in Morro

Bay or a similar type of environment will equal or exceed the area's capacity. It is not reasonable to further restrict Morro Bay's use capacity by initiating or augmenting activities that are not related to its environmental attributes but could be just as easily carried on elsewhere.

Uses of Morro Bay Area

All of the uses that are currently being made of the Morro Bay area and its resources and all proposed uses must be determined. The current and the projected demand for each use must also be established.

Comprehensive Plan Development

The objective of comprehensive area planning is the blending of a number of single-interest plans into one comprehensive plan that provides for maximum attainment of the several objectives at minimum costs.

The process of forming a comprehensive plan starts with a compilation of the single-interest plans that provide for the current uses of the area. Each single-interest plan objective and the program or proposal to attain it must be clear.

Each of the single-interest plans is analyzed in relation to all the plans, and the costs and benefits are determined. The total costs and benefits of all single-interest plans are also determined.

The cost benefit ratio of the unrefined group of single-interest plans is susceptible to improvement. Different combinations of single-interest plans and varying magnitudes of individual plan programs will change the benefits and costs of the comprehensive plan. Different programs for attaining single-interest objectives may eliminate conflicts or reduce resource wastes.

The ultimate comprehensive plan is developed through testing varying combinations of single-interest plans until the overall objectives for the area are attained at a minimum cost.

It must be assumed that there will be new proposals in the future and that the demands for some existing programs will change. A comprehensive plan must be flexible, allowing development by logical stages. New proposals must be evaluated in the existing area combination before they are initiated. Integration of new programs should be done in an orderly fashion.

The evaluation of use programs is a complex economic problem. The expression of benefits and costs must be done through a common denominator, normally the dollar. Even though present ability to precisely set dollar values for all uses is unsatisfactory, planning should proceed in this manner. It is the basis for objective plan decisions. A continuous effort to improve ability in this area should be maintained, and some recognition should be given to those values which cannot be measured in monetary terms.

B. Organization for Comprehensive Area Planning

Three separate and distinct steps are taken during the process of forming an area plan and putting it in operation. These steps are: (1) development of a plan proposal, (2) decision process (adoption), and (3) implementation of the plan. The steps are taken in order, but step 1, on completion, changes from plan development to plan maintenance. No single organization can appropriately take these three steps as each requires a distinctly different discipline and authority.

Development of a Proposed Comprehensive Area Plan

Plan development encompasses all of the staff work needed to prepare a proposal for a decision-making body. The proposed planning area must be delineated, objectives developed, uses determined, and finally an optimum use program must be prepared.

A precept concerning the plan development is that those organizations that will be responsible for the implementation of the plan should be deeply involved in its development.

Preparing a comprehensive plan for any area of significant size involves the interests of many groups, including private as well as public interests. This precludes the possibility of forming a planning group wholly within the State Government, as only a portion of the interests would be represented.

As the Morro Bay area lies entirely within one county, a solution is to augment the San Luis Obispo County Planning Department through State assistance and Federal planning funds and form a planning task force around that nucleus.

The planning task force should be formed to prepare a comprehensive plan proposal from the single-interest plans of all interests. Task force members could come from the State departments of Parks and Recreation, Fish and Game, Harbors and Watercraft, and Division of State Lands; the San Luis Obispo County Planning Department, and City of Morro Bay. The San Luis Obispo County planning officer would act as leader of the task force (see Figure 1).

The various State members would spend whatever time was necessary to introduce the data and plans of their area of interest, consider problems of conflict and propose solutions to them, and continuously review the comprehensive plan as it developed.

The county would provide a fulltime planner until the development of the comprehensive plan is completed to lay out the work schedule and to develop the comprehensive plan from the single-interest plans. This county

PLANNING TASK FORCE, MORRO BAY AREA

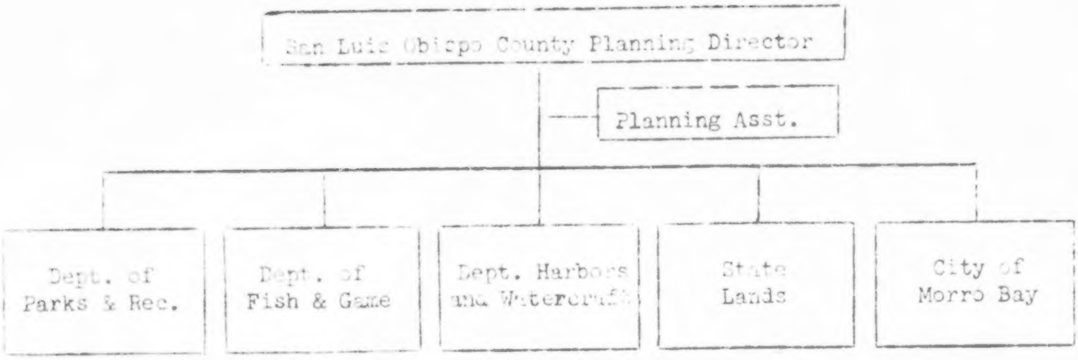

San Luis Obispo County Planning Director
Planning Asst.
Dept. of Parks & Rec.
Dept. of Fish & Game
Dept. Harbors and Watercraft
State Lands
City of Morro Bay

FIGURE 1

planner could be financed through a Federal aid grant obtained through the State Office of Planning.

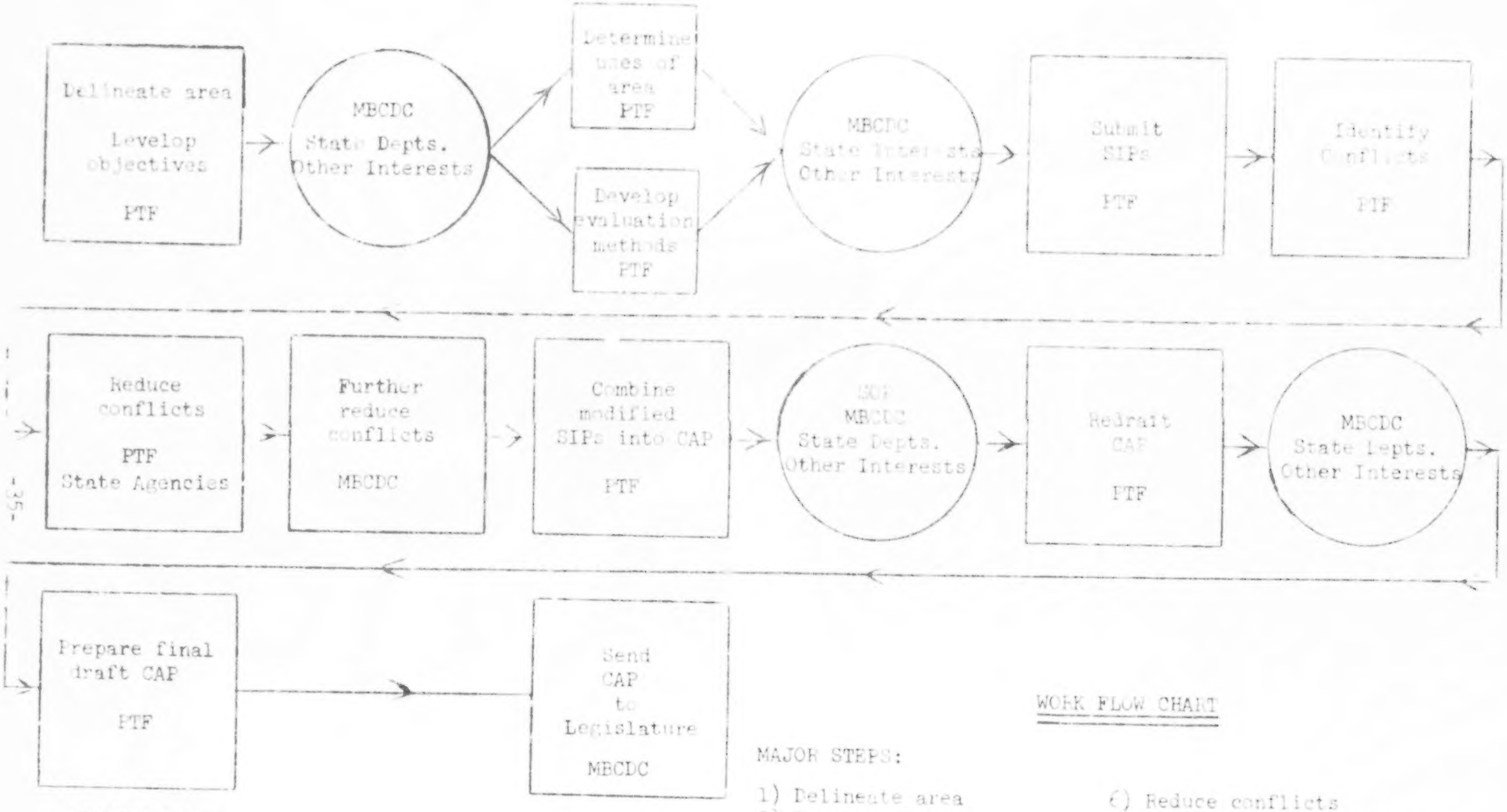
All interests, private as well as public, would be considered by the planning task force. Provisions would be made for their participation in the plan development. In this way involvement of the ultimate users will be achieved through their single-interest plan development and submission, and continual association with the planning group would result in discussing possible solutions to conflicts between interests.

During the development of the plan, there will be conflicts of interests and other problems that cannot be resolved within the planning task force. A decision-making body is needed to resolve such problems as they arise so that the plan can proceed and ultimately to adopt the comprehensive plan proposal.

A "Morro Bay Conservation and Development Commission" made up of representatives of the various interests in the area and including a representative from the State Legislature, the Resources Agency, and the San Luis Obispo County Board of Supervisors could act as a guiding commission, conduct public hearings, and make the necessary decisions during the planning process. When the planning task force produces a comprehensive area plan that is acceptable to the Morro Bay Conservation and Development Commission, the Commission can then submit it to the Legislature (see Figure 2).

C. Implementation

When a comprehensive area plan has been developed for the Morro Bay area, it can be implemented by appropriate levels of government and the


Delineate area
Develop objectives
PTF
MBCDC
State Depts.
Other Interests
Determine uses of area
PTF
Develop evaluation methods
PTF
MBCDC
State Interests
Other Interests
Submit SIPs
PTF
Identify Conflicts
PTF
Reduce conflicts
PTF
State Agencies
Further reduce conflicts
MBCDC
Combine modified SIPs into CAP
PTF
SOP
MBCDC
State Depts.
Other Interests
Redraft CAP
PTF
MBCDC
State Depts.
Other Interests
Prepare final draft CAP
PTF
Send CAP to Legislature
MBCDC

WORK FLOW CHART

ABBREVIATIONS:

SIP	Single interest plan
CAP	Comprehensive area plan
PTF	Planning task force
MBCDC	Morro Bay Conservation and Development Commission

☐ Task ○ Review

MAJOR STEPS:

1) Delineate area
2) Develop objectives
3) Determine uses of area
4) Collect single interest plans
5) Identify conflicts
6) Reduce conflicts
7) Further reduce conflicts
8) Combine modified SIP into CAP
9) Review and modify CAP
10) Adopt a Morro Bay CAP

FIGURE 2

private sector. There is no need for additional organizations.

The State departments would implement their parts of the plan as funds were made available by the Legislature. Some parts of the plan would not require funding. The county's major role would be the zoning of the area to regulate the various uses proposed in the plan. Demands for specific uses would regulate the implementation process of the private sector.

D. Plan Maintenance

Maintenance of a plan entails gathering the data needed for setting program priorities and for evaluating current and proposed programs. These evaluations will lead to plan modification proposals to be submitted to a decision-making body.

Program priorities must be established annually for budget purposes. Current programs must be evaluated in order to do this. Proposed new programs must be evaluated too.

The evaluation of active and proposed programs will lead to recommended modifications of the original plan.

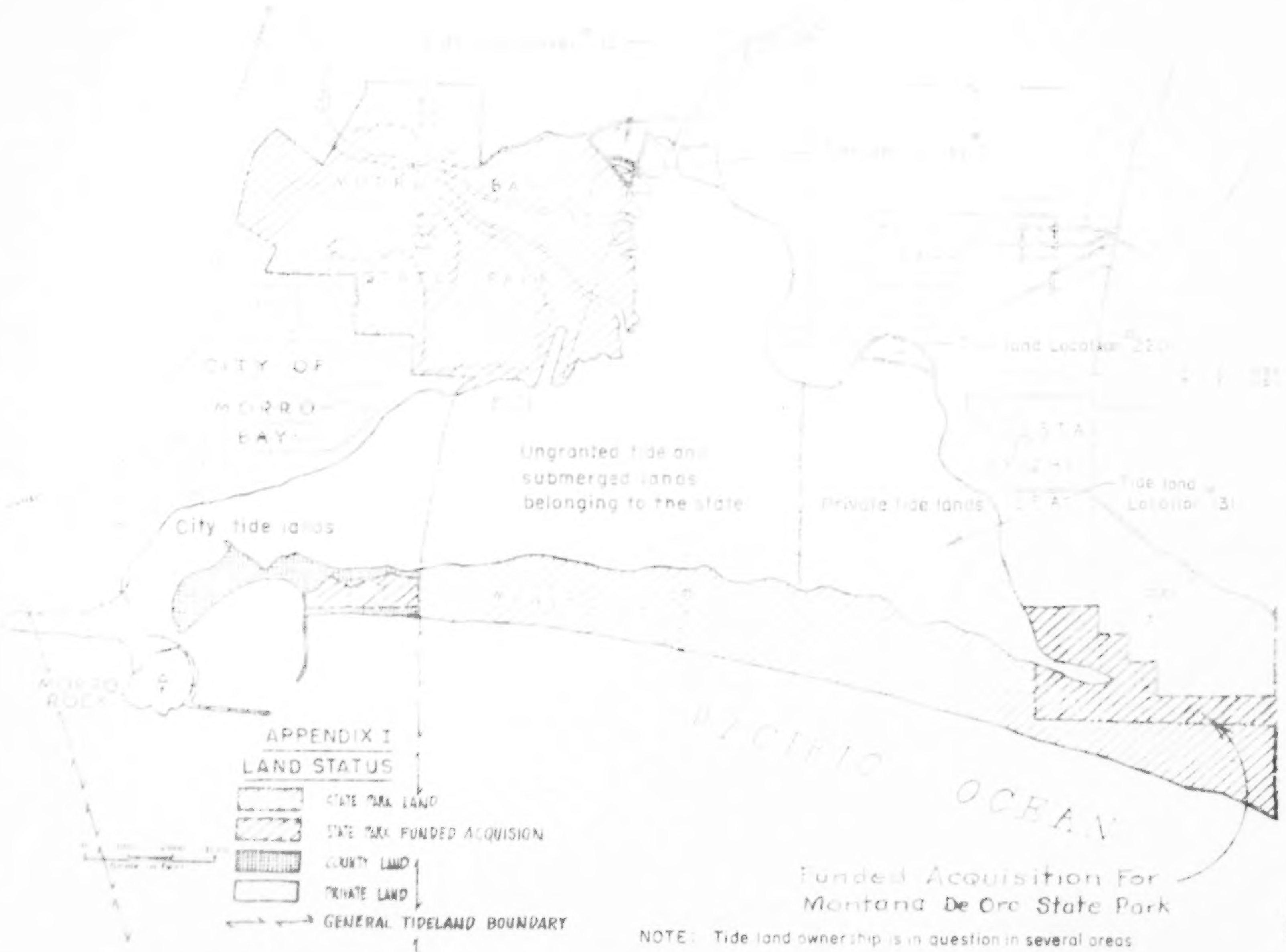
Organization for Plan Maintenance

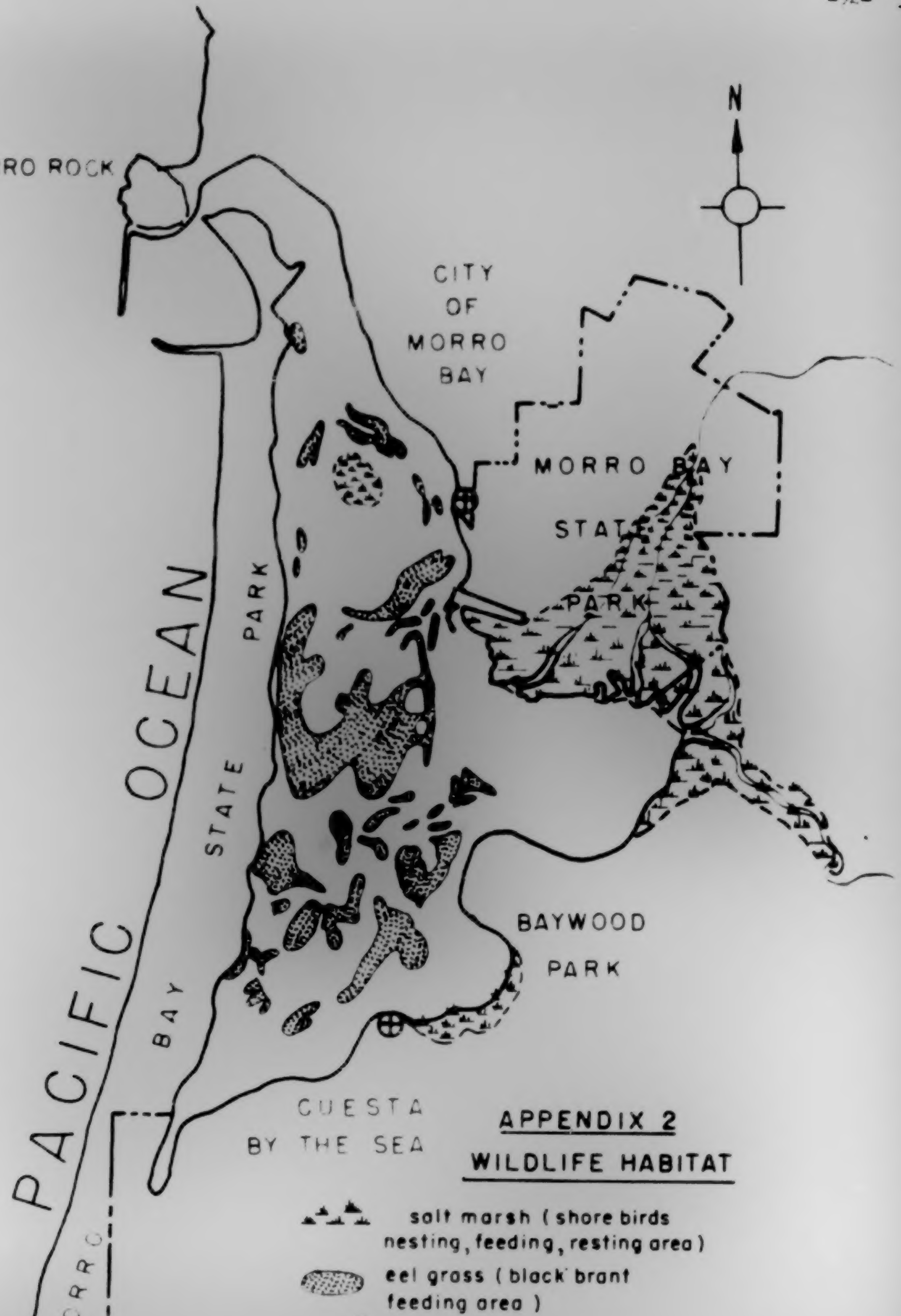
The evaluation of plan modifications will entail the use of the same methods that were used to develop the original plan. The planning task force can best do the work involved in maintenance. It would not be necessary, however, to continue with fulltime members, but the planning group could become a committee instead of a task force and meet as needed to re-evaluate the plan.

Decision-Making Process - Plan Maintenance

The maintenance of the comprehensive plan will require decisions of the same type that were made in establishing the original basic plan. In plan maintenance, a short time span is very desirable. The private sector will be especially appreciative of a system that can quickly give them an answer concerning a plan modification proposal.

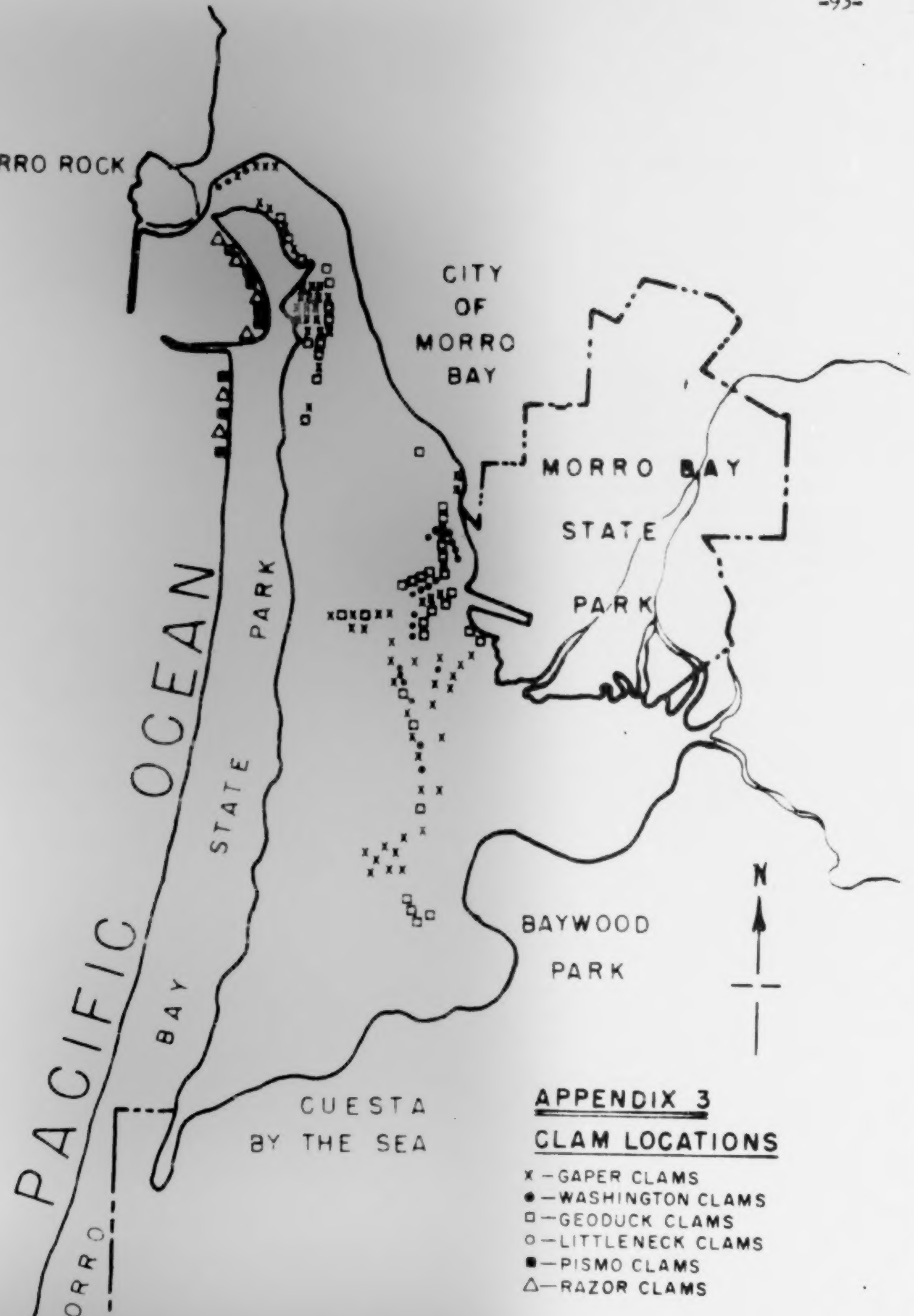
The Morro Bay Conservation and Development Commission should continue as the plan maintenance decision makers. The San Luis Obispo County Planning Director would act as the executive secretary, and the plan maintenance committee under his leadership would do the required staff work.

CITY OF MORRO BAY
City tide lands
Ungranted tide and submerged lands belonging to the state
Private tide lands
Tide land Location 220
Tide land Location 131
MORRO ROCK
PACIFIC OCEAN
APPENDIX I
LAND STATUS
STATE PARK LAND
STATE PARK FUNDED ACQUISITION
COUNTY LAND
PRIVATE LAND
GENERAL TIDELAND BOUNDARY
Funded Acquisition For Montana De Oro State Park
NOTE: Tide land ownership is in question in several areas


N
MORRO ROCK
CITY OF MORRO BAY
MORRO BAY STATE PARK
PACIFIC OCEAN
MORRO BAY STATE PARK
BAYWOOD PARK
CUESTA BY THE SEA
MORRO
salt marsh (shore birds nesting, feeding, resting area)
eel grass (black brant feeding area)
⊕ heron rookery

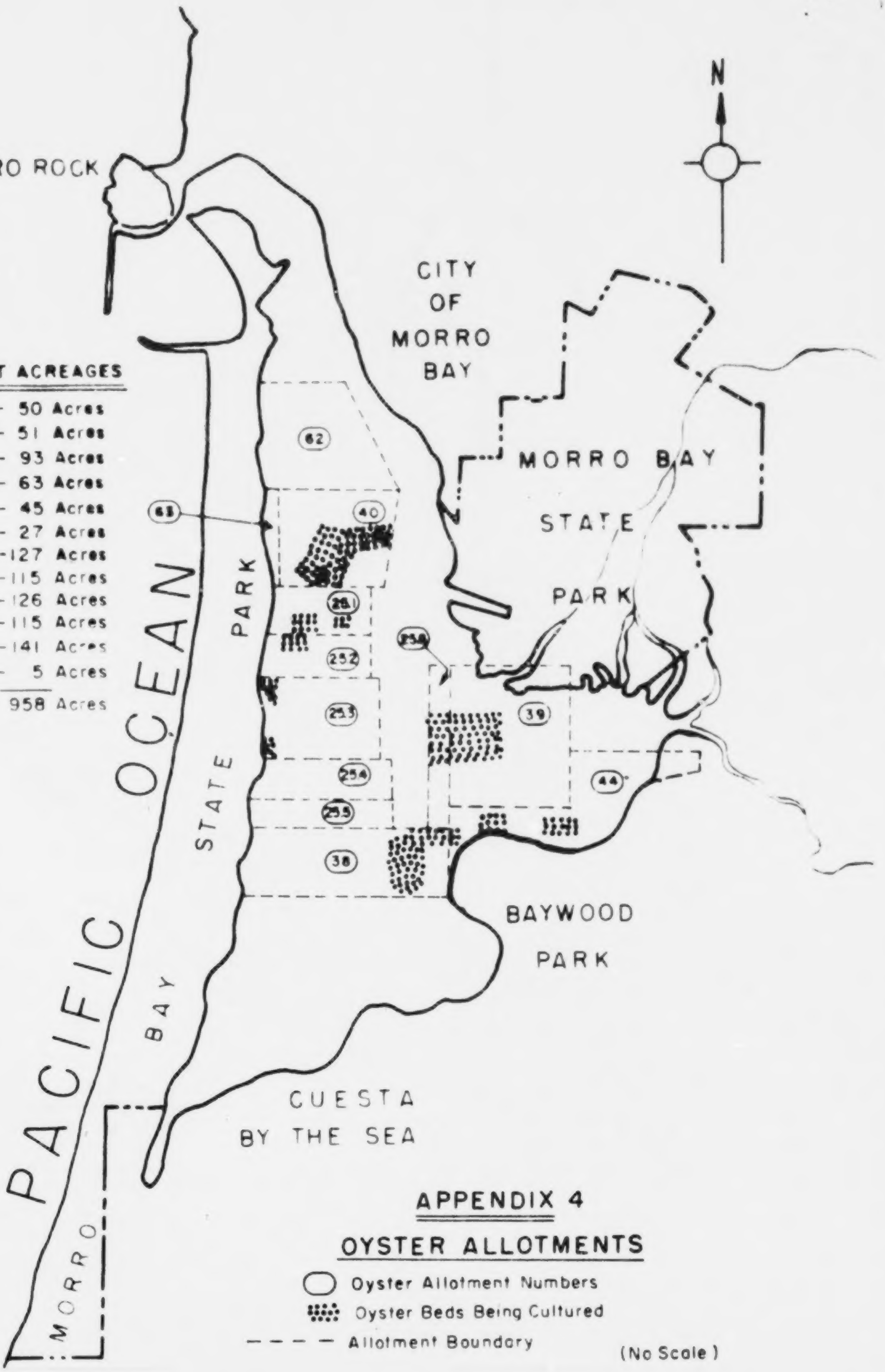
APPENDIX 2

WILDLIFE HABITAT


MORRO ROCK
CITY OF MORRO BAY
MORRO BAY STATE PARK
PACIFIC OCEAN
MORRO BAY STATE PARK
BAYWOOD PARK
CUESTA BY THE SEA
N
X — GAPER CLAMS
● — WASHINGTON CLAMS
□ — GEODUCK CLAMS
○ — LITTLENECK CLAMS
■ — PISMO CLAMS
△ — RAZOR CLAMS

APPENDIX 3

CLAM LOCATIONS


N
MORRO ROCK
CITY OF MORRO BAY
MORRO BAY STATE PARK
PACIFIC OCEAN
MORRO BAY STATE PARK
62
63
40
25.1
25.2
25.3
25.4
25.5
25.6
38
39
44
BAYWOOD PARK
CUESTA BY THE SEA
MORRO

ALLOTMENT ACREAGES

25.1	50 Acres
25.2	51 Acres
25.3	93 Acres
25.4	63 Acres
25.5	45 Acres
25.6	27 Acres
38	127 Acres
39	115 Acres
40	126 Acres
44	115 Acres
62	141 Acres
63	5 Acres
	958 Acres

APPENDIX 4

OYSTER ALLOTMENTS

○ Oyster Allotment Numbers
▨ Oyster Beds Being Cultured
- - - - Allotment Boundary

(No Scale)

STATE OF CALIFORNIA—STATE LANDS COMMISSION RONALD REAGAN, Governor

[redacted]
STATE LANDS DIVISION
1600 L STREET
SACRAMENTO, CALIFORNIA 95814

April 1, 1969

Mr. Irving M. Terzich
Pacific Southwest Division
Federal Water Pollution Control Administration
760 Market Street
San Francisco, California 94102

Dear Mr. Terzich:

Pursuant to the public hearings held on February 18-19 in San Francisco, regarding "Clean Water for the Nation's Estuaries", the following represents the position of the State Lands Division concerning jurisdiction over tide and submerged lands lying between the mean high tide line and the continental shelf boundary with the United States. Division [illegible], Pt. 1, Ch. 4, Art. 1, Section 6301, provides that:

> "The commission has exclusive jurisdiction over all ungranted tide lands and submerged lands owned by the State, and of the beds of navigable rivers, streams, lakes, bays, estuaries, inlets, and straits, including tide lands and submerged lands or any interest therein, whether within or beyond the boundaries of the State as established by law, which have been or may be acquired by the State (a) by quitclaim, cession, grant, contract, or otherwise from the United States or any agency thereof, or (b) by any other means. All jurisdiction and authority remaining in the State as to tide lands and submerged lands as to which grants have been or may be made is vested in the commission.
>
> "The commission shall exclusively administer and control all such lands, and may lease or otherwise dispose of such lands, as provided by law, upon such terms and for such consideration, if any, as are determined by it."

There are many other sections of the Public Resources Code, not set forth herein, which are applicable to the Division's authority to manage, lease and otherwise control land under its jurisdiction.

At the present time, the only authorized use of State tide and submerged lands, including estuaries, bays and inlets, is by permit only. These permits do not normally require a rental, if for public benefit, but the permit procedure is now an effective management tool in assuring a minimization of unauthorized or undesirable uses of these resources.

Some of these lands have been transferred by virtue of legislative enactment to the local political subdivisions of the State of California, i.e. city, county, harbor district, etc. In those cases, some jurisdiction has been transferred to those bodies subject to the public trusts for commerce, navigation and fishery. In almost all cases, the State, through the State Lands Commission, retains a reversionary interest for any major breach of the trust.

At the present time, it would be extremely undesirable to fractionalize the administration and management of portions of the State's holdings by transferring jurisdiction and control to any agency not vested with complete control and management of said State tide and submerged lands.

The State Lands Division is currently involved in many aspects of the proper planning, use, management and control of the subject State lands ranging from the advisability of the establishment of marine reserves and extraction of mineral resources, to the desirability and location of such uses as pipeline easements, moorings, piers and other structures. The integrity of management and control vested in one body for all sovereign lands would appear to be the most desirable course to continue to follow.

If you need any additional information or have any questions about this matter, please do not hesitate to contact me.

Sincerely,

F. J. HORTIG
Executive Officer

cc: N. B. Livermore, Jr.
Secretary for Resources

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
100 McALLISTER STREET
SAN FRANCISCO, CALIFORNIA 94102

SPNED-RS

2 April 1969

Mr. Irving M. Terzich
Pacific Southwest Region
Federal Water Pollution Control
  Administration
760 Market Street
San Francisco, California 94102

Dear Mr. Terzich:

In response to your notice of the public meeting on water quality management for estuaries held in San Francisco on 18 and 19 February 1969, in which three members of my staff attended, the San Francisco District wishes to submit the following statement for inclusion in the testimony.

This office is involved in the San Francisco Bay-Delta Estuary in the areas of water quality and waste disposal, navigation, flood control, maintenance dredging and sometimes Bay fill. We are also responsible for issuing Department of the Army permits related to navigable waters in the Bay system.

Presently, we are preparing a plan of survey for the authorized water quality and waste disposal investigation of the San Francisco Bay, Sacramento-San Joaquin Delta (Triple "S" Investigation). This investigation, initiated in fiscal year 1966, extends through fiscal year 1972.

The objectives of the Triple "S" Investigation, which roughly parallel those of the State of California's San Francisco Bay-Delta Water Quality Program, are to:

a. Assist in implementation of the studies recommended in the State's San Francisco Bay-Delta Water Quality Program final report and initiate supplemental studies which in the opinion of the District should be included;

b. Finalize various alternative waste water disposal plans which will meet water quality objectives imposed by the State Water Resources Control Board and/or FWPCA; and,

c. Define the Federal interest in regional waste water disposal plans proposed.

Keep Freedom in Your Future With U.S. Savings Bonds

SPNED-RS
Mr. Terzich
2 April 1969

One of the studies which the District envisions should be made to supplement those of the State's program is an analysis of the benefits to the public from the San Francisco Bay-Delta Estuary. This study would involve quantifying the present value of the ecological systems and evaluating future uses of the estuary. Traditional methods of evaluating benefits, such as assigning values to various types of recreational uses, appear to be inadequate to estimate the full value of the estuary to the public.

As a part of the Triple "S" Investigation, the San Francisco Bay-Delta Hydraulic Model has been expanded to include the Sacramento-San Joaquin Delta. Since the results of the State's program are based largely on mathematical model studies, this office is of the opinion that the results of the State's studies, where feasible, should be verified and/or expanded on the Hydraulic Model. Specifically the District's model could be used to:

a. Verify operation of the Peripheral Canal including releases for environmental control;

b. Verify required Delta outflow at Antioch to meet the water quality conditions of the "November 19th, 1965 Agreement;"

c. Evaluate dispersion characteristics of the estuary;

d. Determine feasibility of flow augmentation in various parts of the estuary for water quality control;

e. Determine the effects of thermal pollution;

f. Evaluate the effects of future navigation projects on the estuary; and,

g. Explore new methods and/or operations related to disposal of dredged materials.

It is expected that the model will be verified and ready for use by early 1970.

A major authorized navigation project in the estuary is the San Francisco Bay to Stockton Deep Water Ship Channel. This project, nearing the construction phase, consists of deepening the existing ship channel to accommodate super-tankers and other deep-draft vessels. One phase of this project is a study being performed by U.S. Bureau of Sport Fisheries and Wildlife on the effect of dredge spoil disposal.

Other authorized navigation studies and projects underway within the estuary are:

a. Deepening of Oakland Inner Harbor from 30 to 35 feet. This project, currently in the design memorandum stage, will extend 6.2 miles southward from the harbor entrance;

b. A Detailed Project Report is currently underway for deepening of Islais Creek from 35 to 40 feet, and extending the entrance channel and approach area to new Army Street Terminal. Your office is aware of the problem of disposing the dredge spoil due to its high coliform count;

c. A report of survey scope is currently underway to deepen the Redwood City Harbor from 30 to 35 feet to accommodate deep-draft vessels; and,

d. Plans and specifications are underway for the Saucelito Canal Plan of Improvement, which provides for the deepening of the channel to 8 feet from Richardson Bay inland for a distance of about 2.3 miles.

The status of small navigation studies (Federal limitation of $500,000 toward construction of the project) in the estuary are:

a. Reconnaissance reports have been initiated for Mountain View Marina, Palo Alto Yacht Harbor, Coyote Point Marina, Newark Slough and San Francisco West Harbor Facilities;

b. A reconnaissance report has been submitted to higher authority for Gallinas Creek; and,

c. Detailed Project Reports have been submitted or are in progress for Gas House Cove (San Francisco East Harbor Facilities) and Petaluma River.

Project reports on wave action studies of the San Francisco Marina are scheduled for completion this fiscal year.

Preconstruction planning is underway for flood control projects on Napa and Sonoma Creek.

This office represents the Corps of Engineers on the State's San Francisco Bay Conservation and Development Commission (BCDC). I am sure your staff is aware of the recent plan developed by the Commission. The Corps actively participated in the preparation of the plan.

SPNED-RS
Mr. Terzich

2 April 1969

We appreciate the opportunity to present our views on the San Francisco Bay-Delta Estuary. Should you wish further information concerning any projects or studies within the San Francisco District, please let me know.

Sincerely yours,

for FRANK C. BOERGER
Colonel, CE
District Engineer

LEAGUE OF WOMEN VOTERS OF CALIFORNIA
INC.
126 POST STREET ROOM 512 SAN FRANCISCO, CALIFORNIA 94108 986-1532
MRS. JOHN O. AHERN, PRESIDENT

March 13, 1969

STATEMENT ON WATER QUALITY MANAGEMENT FOR ESTUARINE AREAS IN CALIFORNIA

The League of Women Voters of the United States supported the passage of H.R. 25 last year as a tool in the protecting of our national estuaries. In California, as a coastal state, we particularly welcome this study of the effects of pollution on our bays and coastal waters. The League of Women Voters of California, with its 14,000 members, had studied water problems since 1959. In 1966 after considering the state's responsibility for water quality control, members agreed to support high standards for water quality, with responsibility for enforcement at the regional level under the State Water Quality Control Act. We have urged the state to provide more adequate budgets and staff, greater enforcement powers, and better coordination among the agencies responsible for water quantity and quality.

California's estuaries are inestimable in value, ranging from the great economic benefits of our ports to the recreational attractions of our beaches and the quiet haven of lagoons and mudflats for fish and birds. As the most populous state in the union with 20 million people, and one-half million more pouring in annually, we do face great pressure on land and water resources. San Francisco and Los Angeles and San Diego are located on estuaries which have developed into great ports. Near them are located great manufacturing and industrial complexes. These estuaries have a different value from those not yet developed and will continue to serve as centers of commerce and industry, but improvements in municipal and industrial waste management should in time bring water pollution under control.

During the past two years while California has been establishing water quality standards and policies to meet the requirements of the Federal Water Pollution Control Administration, the League of Women Voters of California has supported the program to enhance the qualities of our water. We think Californians want and will pay for clean water in our rivers, deltas, harbors and along our coasts. There is no doubt the federal interest has been a stimulant to raising state standards and objectives of water quality. However, we see the need for sufficient manpower and money to implement these legislative goals. Because of the regional boards heavy workload in formulating and adopting water quality control policies for interstate and coastal waters, there was a decline in staff inspection for waste discharge requirement compliance (from 4553 in period 1965-67 to 3028 in 1966-67). Sufficient staff and money for enforcement are as important as standard setting.

Realizing that there are few remaining undeveloped estuaries in California, we would like to preserve those undistrubed bays and lagoons for their unique values in supporting special biota, migratory and resident birds and fish. But the sound of the bulldozer and boatowner are loud in the land and often drown out the voice of the conservationist. The federal government might help the state resist some of the local pressure groups by establishing protected estuaries as it has wilderness rivers or redwood parks.

In general, we think California has done a good job in controlling pollution since passing the Dickey Water Pollution Act of 1949, changed to the Water Quality Control Act in 1965. However the increasing pressures of population, industry and agriculture increase the waste discharges.

LOS ANGELES

Los Angeles harbor, for instance, leads all other ports in the Western U.S. in total tonnage handled. Its beneficial uses have been defined on shipping, yacht anchorage, industrial cooling and whole fish handling. Long Beach wishes to upgrade the water quality standards to permit fish life to thrive. Waste waters from nearby oil refineries (500,000 barrels a day of oil field brines to into the harbor) and oil spills help deplete the dissolved oxygen. There is evidence that degraded inner harbor water continues to degrade higher quality surrounding waters in Long Beach Harbor, Los Angeles outer harbor, and adjacent coastal waters. Aerial inspection shows discolored water flowing outward from the mouth of Los Angeles Harbor. The dark waters of Dominguez Channel, with industrial waste from oil companies, as well as turbid water from Slip 5 and the West Basin, flow into the inner Harbor and from there into the outer harbor and ocean. The Report of the Los Angeles-Long Beach Harbor Pollution Control Committee, published in November of 1968 states:

"All waters in this area (Los Angeles Inner Harbor north of Vincent Thomas Bridge) have failed to meet present objectives for dissolved oxygen some of the time; waters at the mouth of and in Consolidated Slip, and in Slip 5 have failed to meet the present objectives most of the time. Waters in the West Basin have not met present objectives in most instances in the past three years."

The report also states, "In 1963 and 1964, waters in the Main Channel generally were meeting present objectives. For the last three years, however, waters have not met present objectives most of the time."

Regarding water transparency, the Report states, "Tests illustrate the general reduction in water clarity with increased distance from open ocean." On a 1968 tour of the harbor made by several members of the League of Women Voters, we observed this condition to be true.

At a recent Hearing of the Water Quality Control Board, divers testified that solid materials flowing from the Harbor are deposited on the ocean floor as far as four miles oceanward from the entrance to the Harbor.

The Los Angeles Basin is one of the fastest growing population centers in the United States. The disposal of wastes produced both by people and industry is becoming an increasingly difficult problem and the ocean often seems an easy and accessible dumping ground. What cumulative effects will we see on the ocean plants and life in the next fifteen - twenty years if the present standards are not raised? And if there continues to be more people, more applications to discharge, more industry, and more dischargers?

It is time now to be concerned with the future of our beaches, for the future of facilities for boating, fishing, and other water-related sports. A clean and attractive coast line is a community asset and our growing population will need all possible recreational facilities. A blighted water-front effects the community as much as a blighted neighborhood.

Since population and industry in California have tended to concentrate in coastal communities, 65% of California's sewage and industrial wastes are discharged to salt water. We must be concerned with the effects of this on our marine environment. Catalina island, for instance, dumps raw sewage into the ocean. The treated sewage from our coastal cities is responsible indirectly for the gradual decline of Southern California's coastal seaweed forests. The sewage supports abnormally large populations of sea urchins that destroy the young kelp plants before they get a chance to grow. The Allen Hancock Foundation of University of Southern California completed a synopsis of the state of coastal biology, geology, chemistry and oceanography in 1965 for the State Water Quality Control Board but did not secure much direct information concerning the effects of existing outfalls. Another such survey was recommended at 15 year intervals and certainly we see the need for more research into the effects on our marine environment. The federal government could help the states with oceanic research either through grants or by direct studies. The League sees the need for coordination and continuity in such research planning.

The recent disaster from the oil wells in the Santa Barbara Channel shows us that we need far more information on what kind of industrial use of our ocean resources is appropriate and what safeguards the government should require. It seems we need more exchange of information of this kind between the state and federal government. The citizen can reasonably expect more sharing of expertise at the different levels of government involved. Since both the state and nation have interest and responsibility for the tideland oil development, there should be some institutional mechanism to provide cooperative planning, development and protection of our coastal zones.

The League also thinks we need further research into the possible effects of thermal pollution or radioactive poisoning from the installation of a large nuclear desalination plant at Bolsa Island, near the heavily-populated coastline. Perhaps the dangers have been over publicized but if so the federal government should initiate a program of public education.

SAN FRANCISCO BAY

The San Francisco Bay presents one of the most complex estuarine situations in the world, a large sea inundated valley combined with the drowned mouth of the giant Sacramento-San Joaquin River systems. Problems of pollution began early--over a hundred years ago when the placer cuts of the gold country began bringing vast quantities of silt into the delta and the bay--a process still going on today. Along with increasing industrial and human wastes, indescriminate dredging and filling in the region since that time have placed these waters in a position of jeopardy, which some scientific authorities believe is now irreversible.

Accurate documentation of modern pollution in the estuarine and bay ststem has been developed since the establishment of the Regional Water Quality Control Board in 1950. Over the years this Board has exhibited a remarkable ability to persuade (sometimes with the iron fist in the velvet glove) municipal and industrial polluters to attempt to solve these problems. (A notable exception to this has been San Francisco, where the interaction of antiquated storm and sanitary sewers, a situation until recently largely ignored by politicians and public alike, has resulted today in an intolerable situation). However, the point is not that small or major violations occur, but the fact that these waters cannot continue to absorb wastes-- both from the metropolitan area and the agricultural lands draining into the eastern delta--without potential catastrophic results. As it stands today, the local Regional Water Quality Control Board seems to be fighting just to stay one step ahead of disaster.

The uses to which we believe the waters of the Bay Area should be dedicated are water-related recreation and industry (including shipping and commercial fishing), as well as the preservation of fish and other forms of wildlife. Dredging has been and will continue to be necessary, but it should be planned and executed to achieve the minimum amount of disruption to natural resources and maximum attention paid to the placement of spoils--issues heretofore considered, but not within the context and depth of the total ecological scene until the advent of the Bay Conservation and Development Commission.

However, to achieve the optimum of beneficial uses of water within this area only the implementation of massive projects such as those soon to be proposed by the Bay-Delta Study: namely (1) adequate treatment facilities for the agricultural wastes of the forthcoming San Luis Drain; and (2) a comprehensive regional system for liquid *waste disposal. In addition some means must be made available to prevent the further* intrusion of salt water into inland areas. (A sophisticated collection and treatment system combined with (2) above, suggests a possibility in this area).

Management of this massive estuary has in the past and must continue to involve all levels of government both in planning, finance and development. Increasing concern on the local level revolves around fears that our present State water planning may be geared more to the contract and sale of water rather than to preservation and improvement of existing water quality in the Bay Area; that the Federal government will construct the San Luis Drain without adequate treatment facilities (let alone spend a much less impressive sum on methods of control sewage from their large naval vessels in the Bay itself). Some thoughtful citizens are also concerned about local recalcitrance to the prospect of developing a regional disposal system, if and when it is proposed. Meanwhile, one of these days, we may wake up to salt-laden rivers leading to a dead sea of red algae inside the Golden Gate.

Today the record in California seems to show that we have controlled pollution by establishing state authority, decentralized through use of regional boards with the responsibility to coordinate the efforts of all the state and local agencies involved. The League believes that where localities and states are doing well in managing their estaurine areas, they should be left in charge. However the experiences of San Diego and San Francisco suggest the need for a regional plan and regional authority to effect improvement. If this is not possible, the state should assume the responsibility for our estuaries and coastal zones. Since the federal government is also concerned with these waters,perhaps some kind of federal-state commission or inter-agency commission could be developed. Another federal review of the estuary system in ten years would indicate whether progress or deterioration has taken place under state management.

The League of Women Voters of California appreciates the opportunity to present testimony for this national study of the Federal Water Pollution Control Administratic We hope the results will be widely publicized and presented to the citizen as well as to Congress for the sake of public understanding and informed concern with the future of our estuary systems.

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Portland, Oregon

February 11, 1969

Mr. Irving M. Terzich
Pacific Southwest Region, FWPCA
760 Market Street
San Francisco, Calif. 94102

Dear Mr. Terzich:

While we thoroughly appreciate being invited to testify at the public hearings on estuarine studies in San Francisco February 18-19, we are not in a position to be of much help at this point, having little expertise to offer. We definitely support efforts to identify and preserve the nation's estuarine areas.

Pollution seems the main problem at this time, particularly in areas around San Francisco, Monterey Bay, Los Angeles and San Diego waterway areas, as outfall from commercial plants and sewage of various degrees enters the waters and tidelands. Filling indiscriminately without reference to natural values of tidelands and mudflats is another major problem.

People need to be awakened to the damage being done by both pollution and filling; evaluations need to be done of what estuarine areas mean to the total environment so that control of what is put into them may be based on evidence of what they contribute. Too many people regard these areas as simply unsightly mudflats or sloughs of doubtful esthetic value; action to preserve and clean them up must be predicated upon realization of their place in the total picture of man's environment and their contribution to it.

Sincerely,

Betty Hughes

Mrs. Betty Hughes, Secretary

LEEDS, HILL AND JEWETT, INC.
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March 1, 1968

Honorable Board of Directors
Contra Costa County Water District
2020 Railroad Avenue
Pittsburg, California 94565

Gentlemen:

We are pleased to transmit herewith our Master Plan Report for water supply for the Contra Costa County Water District, prepared in accordance with our agreement dated April 5, 1966. A rate study report, also required by the agreement, is being published concurrently with but bound separately from this Report.

Our investigations show that there is an urgent need for the proposed Kellogg Unit of the Federal Central Valley Project, or an alternate thereto, and that every effort should be made to achieve its realization at the earliest possible time. The District must have a project to replace the existing Rock Slough intake to the Contra Costa Canal in operation by 1976 at the very latest.

We find further that the capacity of the existing Contra Costa Canal system will need to be augmented in the near future and that certain modifications and improvements to the Canal system will be required if it is to continue to provide adequate water service to the District's customers. The recommended development schedule for these improvements presented in the Report calls for construction of certain features to begin immediately, with the improvement program to be largely completed by 1976. The major components of the proposed improvement program include construction of a pipeline from the Contra Costa Canal at Clyde to Martinez Reservoir; filling of the Canal downstream from the southern boundary of the United States Naval Reservation at Concord, replacing it with a pipeline system constructed in the Canal right-of-way; enlargement of the Canal flow section from the beginning of Section 5 to the turnout serving the District's Treated Water Division; and augmentation of the capacity of the four main pumping plants on the Canal.

We recommend that the District continue to press for rapid completion of the feasibility report being prepared by the United States Bureau of Reclamation supporting the proposed Kellogg Unit, and, assuming that the terms and conditions presented therein as to water charges are fair and reasonable, that the District urge authorization and funding of the Unit by the Congress at the earliest possible date. We further recommend that the program for improvements to the Contra Costa Canal system proposed herein be implemented, and that the District begin consultations immediately with the Bureau of Reclamation to that end.

If it becomes apparent, after consultation with the various concerned Federal agencies including the Bureau of the Budget, that there is no reasonable probability that the Bureau of Reclamation can construct the Canal improvements within the required time schedule, the District should then take steps to implement the improvement program itself, either in its entirety or to the extent that it cannot be accomplished by the Bureau within the time limits. In this case, Congressional approval should be sought for the District to take over ownership of the Canal system after payout.

We would like to take this opportunity to express our appreciation of the superior work contributed to this investigation by the District's engineering staff, who carried out most of the necessary detailed studies under our direction. Their competence and cooperation, together with that of the General Manager and his administrative staff, were invaluable. We also gratefully acknowledge the cooperation of the United States Bureau of Reclamation, the State of California Department of Water Resources, the District's Treated Water Division, and the many municipalities, industries, and individuals who provided information and assistance necessary to the investigation.

Very truly yours,

Harvey O. Banks

HARVEY O. BANKS
President

C
C
water

CONTRA COSTA COUNTY WATER DISTRICT

MASTER PLAN
FOR
WATER SUPPLY

MARCH 1968

LEEDS, HILL AND JEWETT, INC., CONSULTING ENGINEERS
SAN FRANCISCO — LOS ANGELES

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17	Proposed Improvement Program, Contra Costa Canal System

All Plates are bound at the end of the Report.

REFERENCES

1. Report of Central Contra Costa County Committee on Study of Water Agency Service Area Boundaries. April, 1962.

2. Contra Costa County Land Use and Circulation Plan - 1985. Contra Costa County Planning Commission. June, 1963.

3. Appendix B to "Future Development of the San Francisco Bay Area, 1960-2020." U.S. Department of Commerce. December, 1959.

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6. Residential Water Use Research Project; by F. P. Linaweaver, Jr., J. C. Geyer, and J. B. Wolff. Johns Hopkins University. June, 1966.

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9. Water Requirements in the Vicinity of Mountain View Reservoir; by J. O. Nelson, District Engineer. Contra Costa County Water District. January, 1966.

10. Modification of the Contra Costa Canal, Central Valley Project, Between Clyde and Martinez, California; by A. J. Hanson and J. E. Cook. United States Department of the Interior, Bureau of Reclamation. March, 1967.

11. Contra Costa Canal Water Requirements in Diablo Valley; by J. O. Nelson, District Engineer. Contra Costa County Water District. January, 1967.

I. INTRODUCTION

A. AUTHORITY

This Report has been prepared pursuant to an agreement dated April 6, 1966, between the Board of Directors of the Contra Costa County Water District and Leeds, Hill and Jewett, Inc., Consulting Engineers. That agreement authorized the Engineers to "direct and be responsible for the formulation of a Master Plan and Rate Study" for the District, in order to ensure that the foreseeable water requirements within the District will be provided for in an economic, engineeringly sound, and financially feasible manner.

B. SCOPE

This Report presents the results of studies leading to:

(1) Determination of future requirements for high quality water within the present and potential service area of the Contra Costa County Water District;

(2) Determination of potential sources of supply for the District's water needs;

(3) Selection of a plan for modification and expansion of the existing Contra Costa Canal system to meet future requirements for service;

(4) Recommendations for a financial plan to enable the District to effect the proposed improvements;

(5) Determination of the costs which the District would bear if it were to take over operation and maintenance of the existing Contra Costa Canal system.

The Report is primarily concerned with the problems of raw water supply and the conveyance of raw water. The problems of treatment and distribution of finished water within the District's Treated Water Division were examined in a Master Plan report prepared for TWD by another firm in 1964.

Analysis of the District's present rate structure, general recommendations regarding rate structure policy, and determination of an interim water rate schedule are presented in a separate report which can be considered as an addendum to this Report. The Rate Structure report has been bound separately from the Master Plan Report, since the District's rate structure will require review and revision more frequently than will its long-range master plan for development.

The Master Plan studies and the financial plan presented in this Report presume that the proposed Kellogg Unit of the Federal Central Valley Project will be constructed and in operation within the next seven or eight years. However, investigations are now underway of alternative projects which could be constructed by the District if it develops that this timetable cannot be realized. If a District-sponsored alternative to the Kellogg Unit is undertaken, the financial plan presented in this Report will require revision. The proposed plan for modification of the distribution system beyond Contra Loma Reservoir would probably not be affected by a revision in concept of the source water supply project, although the plan should then be reviewed.

II. STUDY AREA

A. DESCRIPTION OF AREA

1. CONTRA COSTA COUNTY

a. History. In 1848, Contra Costa County was established as one of the original counties forming California when the State was admitted to the Union. Subsequently, in 1853, the County was partitioned by the creation of Alameda County from its southern and eastern lands.

Contra Costa County was for many years principally devoted to grazing and agricultural activities, but since the turn of the century it has become increasingly important as a major industrial and urban center, and now encompasses one of the largest heavy industrial complexes in the State.

b. Geography. Contra Costa County lies at the northern extremity of the Diablo Range, and is bounded by San Francisco and San Pablo Bays to the west, Suisun and Honker Bays and the San Joaquin River to the north, and Old River to the east. These waters are subject to tidal influences from the Pacific Ocean.

The eastern portion of the County lands which lend themselves to development lie in the flat plains of the Sacramento-San Joaquin Delta, the central portion in the narrow valleys of San Ramon, Walnut, and Mount Diablo Creeks, and the western portion on the narrow coastal plains and tidelands fronting on San Francisco Bay. Separating the central and western portions of the County are the Berkeley Hills, while Mount Diablo and its foothills lie between the central and eastern portions. A relatively narrow strip of partially developed land fronts the northern edge of the County along the Sacramento-San Joaquin Delta and Suisun Bay.

c. Climate. The climate of the County is characterized by warm, dry summers and cool, moist winters. Variations in temperature from one section of the County to another are the result either of the cooling effects of the Pacific Ocean and neighboring bays, or of topographic influences. Precipitation occurs almost exclusively during the winter months, and rainfall is negligible throughout the County during the growing season from May through September. Irrigation is essential to the success of commercial agriculture.

The climatic characteristics of Contra Costa County are summarized in Table 1. In general, temperature increases and precipitation decreases from west to east across the County.

d. Economic Base. Contra Costa County is the center of heavy industrial development in Northern California. In 1965, total investment in industrial plant and equipment exceeded $2 billion. Seventeen different industries each had more than 500 employees, while an additional 12 industrial plants employed more than 250 persons each. Major industries represented in the County include oil refining, steel manufacturing, paper and paper products, chemicals, and food products processing and packing. The electronics and aerospace industries are growing rapidly. While agriculture is no longer a primary industry, farm income in the eastern portions of the County still averages about $25 million annually.

Contra Costa County is a significant West Coast shipping center. Its wharves presently handle approximately 62% of all the water-borne shipping of San Francisco Bay, and 34% of the shipping of all California ocean ports. The United States Navy maintains a large installation at Port Chicago, through which substantial quantities of military materiel pass.

Other transportation facilities include ample highway access, rail service by three major railroads, and a public airport adequate for use by light planes. In addition, the Bay Area Rapid Transit system now under construction will provide modern, high-speed commuter service to the hub cities of San Francisco and Oakland from Richmond, Lafayette, Walnut Creek, and Concord. Plans call for future extension of the system to Pittsburg, Antioch, and Brentwood.

e. Water Supply Agencies. Agencies providing raw water supplies to areas of Contra Costa County for municipal, industrial, and agricultural purposes are: Contra Costa County Water District, East Bay Municipal

TABLE 1

CLIMATIC CHARACTERISTICS OF CONTRA COSTA COUNTY

Station	Temperature, °F			Average Annual Precipitation, inches
	Average High	Average Low	Average Annual	
Richmond	66.3	50.0	58.1	22.05
Period of Record	1951-1960		1951-1960	1951-1960
Walnut Creek (2ESE)	71.9	44.9	58.1	19.69
Period of Record	1949-1960		1948-1966	1901-1966
Port Chicago (Naval Depot)	71.6	43.3	57.5	14.49
Period of Record	1947-1960		1947-1960	1946-1966
Antioch (Fibreboard Mills)	74.1	47.4	61.5	12.70
Period of Record	1918-1960	1919-1960	1882-1966	1879-1966

Source: U. S. Weather Bureau records.

Utility District, East Contra Costa Irrigation District, and Byron-Bethany Irrigation District. The latter two agencies supply only agricultural water in their service areas which are located in the eastern portion of the County.

These four agencies are delineated on Plate 1, which shows only that portion of the County lying to the east of the East Bay Municipal Utility District service area; only the eastern boundary of that District is shown.

2. CONTRA COSTA COUNTY WATER DISTRICT

a. Formation and Function. The Contra Costa County Water District was organized May 5, 1936, as the legal entity to contract with the United States for the purchase and distribution of water from the Contra Costa Canal Unit of the Federal Central Valley Project. The District sells raw water to individual domestic, industrial, and agricultural water users, to municipalities, and to other public agencies, some of which treat the water and retail it to individual customers. It is the objective of the District to ensure the availability of a water supply to its lands and inhabitants, adequate in quantity and quality to meet all foreseeable needs, from either the Federal Central Valley Project or from some alternative source or both.

Since 1961, when it purchased the facilities of the California Water Service Company, the District has also been a purveyor of treated municipal and industrial water supplies. This function has been carried out through the Treated Water Division of the District.

b. Powers and Limitations. The Contra Costa County Water District was formed and operates under the County Water District Law (Water Code, Division 12). This law gives broad powers to the District which enable it to "perform any act necessary to furnish sufficient water to the District for any present or future beneficial use..." (Water Code, Section 31020). The District may undertake the storage, conservation, treatment, and distribution of water; drainage and reclamation of land; development and distribution or replenishment of ground water; provision of service for collection and disposal of garbage, waste and trash; and acquisition and operation of facilities appropriate to the recreational use of water. The District may plan, construct, and operate any necessary facilities; may set rates for water sufficient to yield monies to pay for a portion of or all costs; may levy taxes to pay a portion of or all costs; may incur bonded indebtedness of the District as a whole or of specially defined improvement zones; and may restrict or prohibit the wastage of or the use of District water during periods of emergency caused by drought or other threatened or existing water shortage for any purposes other than household uses or such other uses that may be determined to be necessary. In order to incur general obligation bonded indebtedness, the District must obtain the approval of two-thirds of those voting at a bond election. A majority vote is sufficient for approval of revenue bonds.

c. Service Area. Originally, the District contained about 48,000 acres lying along the northern shore of Contra Costa County and extending into Clayton and Ygnacio Valleys. Over the years, annexations have enlarged the District until it now encompasses about 109,000 acres. The present boundary of the District is shown on Plate 1; the District's historic growth is summarized in Table 2.

d. Present Customers. The Contra Costa County Water District at present sells raw water to a total of 1,259 different customers, including its own Treated Water Division. However, by far the greatest portion of total water sales is delivered to a relatively few major customers consisting of municipalities and industries which purchase 500 acre feet or more annually each. In the fiscal year ending June 30, 1967, 91% of the District's total sales were made to the following 15 customers:

City of Antioch
City of Pittsburg
City of Martinez
City of Pleasant Hill
CCCWD, Treated Water Division
Bay Water Service
Oakley County Water District
Crown Zellerbach Corporation
Dow Chemical Company
Fibreboard Paper Products Corporation
Monsanto Chemical Company
Phillips Petroleum Company
United States Steel Corporation
Shell Chemical Company
Shell Oil Company

The remaining customers are primarily agricultural water users; smaller commercial and industrial organizations; municipal customers including cemeteries, golf courses, and schools; and individuals and groups which divert water directly from the Contra Costa Canal principally for domestic irrigation purposes. Individuals of this type are termed "Flat Raters" by the District. Of these remaining customers, agricultural users purchased 5% of the total water delivered by the District in fiscal year 1967, so that all the other customers combined accounted for only 4% of the District's sales. A summary of the number of customers in each use category is shown in Table 3.

The District has sold a small amount of water in the past under special contract to the City of Benicia, in Solano County. These supplies are delivered through a 10-inch diameter pipeline carried on the Benicia-Martinez Bridge. The pipeline was originally constructed by the United States Department of Defense to provide service to the Benicia Arsenal, which has since been abandoned.

3. STUDY AREA

a. Definition. The total area considered for analysis in this Master Plan study is shown on Plate 2. The area is defined as that portion of the County lying to the east of the recommended ultimate boundary of the East Bay Municipal Utility District, as described in reference 1, and a line extending from the southeastern extremity of that recommended boundary along the natural watershed line to the Contra Costa-Alameda County line. It is considered probable that all of this area may eventually depend on the District for raw water supplies for municipal and industrial uses and for some agricultural uses. A substantial portion of the study area lies within the present District boundaries.

b. Sub-Areas. For purposes of analyzing population patterns and water requirements, the study area was divided into 11 sub-areas as shown on Plate 2.

When planning a water supply system serving a single relatively homogeneous area, it is usually satisfactory to estimate municipal water requirements by multiplying anticipated future population by a factor representing over-all per-capita use. However, for

TABLE 2

GROWTH OF
CONTRA COSTA COUNTY WATER DISTRICT

Year	Area Within District, Acres	Year	Area Within District, Acres
1936	48,000	1958	82,832
1950	79,000	1959	95,216
1951	79,000	1960	107,488
1952	81,470	1961	107,488
1953	81,470	1962	107,832
1954	82,118	1963	107,966
1955	82,223	1964	106,613
1956	82,223	1965	108,913
1957	82,897	1966	108,914

TABLE 3

CUSTOMERS OF
CONTRA COSTA COUNTY WATER DISTRICT

Type of Customer	Number of Customers[a]
Municipal	16
Industrial	21
Agricultural	230
Groups	47
Flat Raters[b]	945
	1,259

a/ As of December 1967.

b/ Individuals.

analysis of the Contra Costa Canal, a 48-mile long facility serving a multiplicity of varying uses along its length, this approach is not satisfactory. It was necessary to establish study sub-areas which would reflect to a reasonable extent the distinctly different characteristics of the various areas served by the Canal.

The boundaries selected for the study sub-areas were generally determined as the planning boundaries of municipal water systems, as ultimate city boundaries shown in land use planning reports, or as natural geographic boundaries where the other two criteria did not apply or were not appropriate.

B. LAND USE

1. PRESENT

Present land use patterns within the study area are highly variable, ranging from predominantly agricultural use in the eastern portion of the area to the intensely developed residential and commercial areas of Martinez, Pleasant Hill, and Concord in the west. A strip of heavy industrial development fronts the Sacramento and San Joaquin Rivers, extending westerly from Oakley and including areas surrounding Antioch, Pittsburg, Nichols, and Martinez. Another significant feature is the United States Naval Reservation at Concord. A summary of the 1962 land use patterns in the study area is shown in Table 4, as taken from land use survey maps prepared in that year by the Contra Costa County Planning Commission.

2. FUTURE

In estimating the future land use patterns for the study area, a number of land use plans were reviewed. The plan which appears to be the most consistent with current trends, and also is the most likely to be effectuated through action by the County Board of Supervisors, is the County Planning Commission's "Land Use and Circulation Plan - 1985," reference 2. This land use plan has been accepted as an adequate basis for predicting future population and municipal water requirements in the

TABLE 4

1962 LAND USE IN STUDY AREA

Area	Land Use Category[a/] Industrial Acres	Industrial % [b/]	Residential Acres	Residential % [b/]	Commercial Acres	Commercial % [b/]	Public Acres	Public % [b/]	Total Developed Area, Acres
Total Study Area	6,209	21.5	18,538	64.4	1,473	5.1	2,581	9.0	28,801
Sub-areas									
Martinez	1,221	34.4	2,119	59.7	144	4.1	65	1.8	3,549
Central County	2,985	17.2	11,586	66.8	843	4.9	1,918	11.1	17,332
Nichols	329	29.3	639	56.9	94	8.4	60	5.4	1,122
Pittsburg	1,030	44.6	898	38.9	176	7.6	206	8.9	2,310
Antioch	568	20.3	1,855	66.3	107	3.8	267	9.6	2,797
Oakley	76	39.0	90	46.1	29	14.9	-	-	195
Brentwood	-	-	847	91.8	35	3.8	41	4.4	923
Byron	-	-	60	62.5	12	12.5	24	25.0	96
Islands	-	-	444	93.1	33	6.9	-	-	477
Nortonville-Somersville	-	-	-	-	-	-	-	-	-
Mt. Diablo-Los Meganos	-	-	-	-	-	-	-	-	-

[a/] Excluding agricultural land.
[b/] Percentage of total developed area.

Source: Contra Costa County Planning Commission survey maps for 1962.

TABLE 5

PROJECTED 1985 LAND USE IN STUDY AREA

Area	Industrial Acres	Industrial % b/	Residential Acres	Residential % b/	Commercial Acres	Commercial % b/	Manufacturing Acres	Manufacturing % b/	Public Acres	Public % b/	Parks c/ Acres	Parks c/ % b/	Total Developed Area, Acres
	Land Use Category a/												
Total Study Area	19,744	25.2	53,477	68.0	2,083	2.6	1,438	1.8	903	1.1	1,044	1.3	78,689
Sub-areas													
Martinez	1,270	16.7	6,086	80.3	158	2.5	-	-	-	-	37	0.5	7,582
Central County	7,514	20.0	26,348	70.3	1,066	2.9	1,315	3.5	613	1.6	630	1.7	37,486
Nichols	2,460	52.9	1,843	39.6	37	0.8	-	-	-	-	311	6.7	4,651
Pittsburg	2,390	32.7	4,545	62.4	216	3.0	-	-	99	1.4	37	0.5	7,287
Antioch	4,480	41.0	5,942	54.4	276	2.6	-	-	191	1.7	29	0.3	10,918
Oakley	1,510	52.1	1,324	45.6	63	2.3	-	-	-	-	-	-	2,897
Islands	-	-	2,552	97.6	63	2.4	-	-	-	-	-	-	2,615
Brentwood	120	3.3	3,144	89.1	145	4.2	123	3.4	-	-	-	-	3,532
Byron	-	-	1,693	98.2	30	1.8	-	-	-	-	-	-	1,723
Nortonville-Somersville	-	-	-	-	-	-	-	-	-	-	-	-	-
Mt. Diablo-Los Meganos	-	-	-	-	-	-	-	-	-	-	-	-	-

a/ Excluding agricultural land, regional parks, and open space.
b/ Percentage of total developed area.
c/ Excludes regional parks.

Source: Contra Costa County Planning Commission Land Use and Circulation Plan.

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Master Plan study area. To a great extent, the District's Master Plan for water supply is designed to support the County's land use and circulation plan.

The pattern of land use in the study area in year 1985, as projected in the County plan, is depicted on Plate 3 and summarized in Table 5. The County Planning Commission's values for industrial land use acreages for both the 1962 and the 1985 levels of development require some clarification. At the 1962 level, these represent more closely the total land holdings of industries in the area than the actually developed acreages. Similarly, at the 1985 level the figures represent area which would be set aside for long-term future development as industrial sites, and do not necessarily indicate the level of industrial development at that time.

C. POPULATION

1. HISTORICAL

As a guide in projecting the future population of the study area and sub-areas, the historical populations of these areas were first developed by analysis of United States Bureau of Census data from 1930 through 1960. These historical population data are summarized in Table 6.

2. FUTURE

As a first step in predicting future populations, a projection for all of Contra Costa County was adopted and was split between population within and outside of the study area. After review of a number of projections for the County made by various Federal, State, and local agencies, the United States Bureau of Census Series 2-IV projection was accepted, reference 3. This projection most closely approximates actual trends which have developed since it was made in 1959, and appears to recognize the area's growth potential. The projected County-wide population was then distributed within and outside the study area by consideration of the historical distribution patterns and by extrapolation of current trends using data presented in the so-called "2020 Report," reference 4.

The projections of the total population of Contra Costa County and the portion within the study area are listed in Table 7 and are shown graphically on Plate 4.

In distributing the study area population projection to the 11 sub-areas, the County Planning Commission's land use pattern and density criteria were utilized. As a first step, density factors were developed which fell within the County Planning Commission's permissible range and which, when applied to the 1962 land use data, gave a total study area population matching the population for 1962 extrapolated from the historical trend 1930-1960. This computation is shown in Table 8. Next, these density factors were applied to the 1985 land use plan to estimate the 1985 population in each sub-area and in the total study area, as shown in Table 9. Only minor adjustments were necessary to obtain excellent agreement between this computation of the 1985 population and the corresponding value estimated as described in the preceding paragraph and listed in Table 7.

With the aid of this 1985 "bench mark" and the historical 1930-1960 population data, growth curves of population were constructed for each sub-area to the year 2020, with minor internal adjustments being made so that the total of the curve values matched the previously estimated study area total. In making these adjustments, consideration was given to the net area developable for residential use in each of the sub-areas. The anticipated future populations projected by this method for each sub-area are listed in Table 10.

TABLE 6

HISTORICAL POPULATION OF STUDY AREA

Area	1930	1940	1950	1960
Total Study Area	37,000	45,940	87,560	161,130
Sub-areas				
Martinez	9,680	10,870	12,000	15,620
Central County	6,060	9,210	31,600	85,220
Nichols	1,610	2,190	5,680	8,570
Pittsburg	9,160	9,520	15,320	21,190
Antioch	5,500	6,890	13,000	19,210
Oakley	710	730	1,280	1,630
Islands	700	710	1,290	1,390
Brentwood	2,500	4,570	5,960	6,790
Byron	1,080	1,250	1,230	1,310
Nortonville-Somersville	-	-	50[a]	50[a]
Mt. Diablo-Los Meganos	-	-	150[a]	150[a]

[a] Approximate.

Source: U. S. Bureau of Census data.

TABLE 7

PROJECTED POPULATION OF CONTRA COSTA COUNTY AND STUDY AREA

Population In Thousands

Year	Contra Costa County[a]	Study Area
1970	652	267
1980	992	427
1985	1,198	527
1990	1,428	632
2000	1,888	870
2010	2,342	1,116
2020	2,800	1,356

[a] Source: U. S. Bureau of Census Series 2-IV, extrapolated to 2020.

TABLE 5

DERIVED 1962 POPULATION OF STUDY AREA

	Residential Area Density									
	Low Density			Medium Density			High Density			
Area	Net Acres	a/ Families	b/ Persons	Net Acres	c/ Families	b/ Persons	Net Acres	d/ Families	b/ Persons	Total Population
Total Study Area	3,945	5,918	20,358	1,204	3,612	12,425	8,439	42,201	145,171	177,954
Sub-areas										
Martinez	668	1,002	3,447	163	489	1,682	708	3,540	12,178	17,307
Central County	2,584	3,876	13,333	1,041	3,123	10,743	4,726	23,630	81,287	105,363
Nichols	-	-	-	-	-	-	447	2,235	7,688	7,688
Pittsburg	-	-	-	-	-	-	898	4,496	15,466	15,466
Antioch	294	411	1,517	-	-	-	1,024	5,120	17,613	19,130
Oakley	6	9	31	-	-	-	57	285	980	1,011
Islands	-	-	-	-	-	-	311	1,555	5,350	5,350
Brentwood	393	590	2,030	-	-	-	226	1,130	3,887	5,917
Byron	-	-	-	-	-	-	42	210	722	722
Nortonville-Somersville	-	-	-	-	-	-	-	-	-	e/
Mt. Diablo-Los Meganos	-	-	-	-	-	-	-	-	-	e/

a/ @ 1.5 families per net acre.
b/ @ 3.44 persons per family.
c/ @ 3.0 families per net acre.
d/ @ 5.0 families per net acre.
e/ Negligible.

Note: Acreage and density factors obtained from Contra Costa County Planning Commission data.

Net acreage is the gross acreage minus the area of streets and roads, parks, schools, commercial and other nonresidential uses.

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TABLE 5

PROJECTED 1985 LAND USE IN STUDY AREA

Area	Land Use Category a/												Total Developed Area, Acres
	Industrial		Residential		Commercial		Manufacturing		Public		Parks c/		
	Acres	% b/	Acres	% b/	Acres	% b/	Acres	% b/	Acres	% b/	Acres	% b/	
Total Study Area	19,744	25.2	53,477	68.0	2,083	2.6	1,438	1.8	903	1.1	1,044	1.3	78,689
Sub-areas													
Martinez	1,270	16.7	6,086	80.3	158	2.5	-	-	-	-	37	0.5	7,580
Central County	7,514	20.0	26,348	70.3	1,066	2.9	1,315	3.5	613	1.6	630	1.7	37,486
Nichols	2,460	52.9	1,843	39.6	37	0.8	-	-	-	-	311	6.7	4,651
Pittsburg	2,390	32.7	4,545	62.4	216	3.0	-	-	99	1.4	37	0.5	7,287
Antioch	4,480	41.0	5,942	54.4	276	2.6	-	-	191	1.7	29	0.3	10,918
Oakley	1,510	52.1	1,324	45.6	63	2.3	-	-	-	-	-	-	2,897
Islands	-	-	2,552	97.6	63	2.4	-	-	-	-	-	-	2,615
Brentwood	120	3.3	3,144	89.1	145	4.2	123	3.4	-	-	-	-	3,532
Byron	-	-	1,693	98.2	30	1.8	-	-	-	-	-	-	1,723
Nortonville-Somersville	-	-	-	-	-	-	-	-	-	-	-	-	-
Mt. Diablo-Los Meganos	-	-	-	-	-	-	-	-	-	-	-	-	-

a/ Excluding agricultural land, regional parks, and open space.
b/ Percentage of total developed area.
c/ Excludes regional parks.

Source: Contra Costa County Planning Commission Land Use and Circulation Plan.

TABLE 10

PROJECTED POPULATION OF STUDY AREA

Population In Thousands

Area	1970	1980	1985	1990	2000	2010	2020
Total Study Area	267	427	527	632	870	1,116	1,356
Sub-areas							
Martinez	23	38	49	62	92	118	136
Central County	151	219	253	286	354	420	470
Nichols	12	18	22	26	32	36	39
Pittsburg	33	48	57	63	75	84	90
Antioch	27	48	63	78	106	128	148
Oakley	3	10	14	18	26	32	36
Islands	5	20	31	42	62	76	86
Brentwood	11	20	27	38	75	128	191
Byron	2	6	11	19	48	94	160
Nortonville-Somersville[a/]							
Mt. Diablo-Los Meganos[a/]							

[a/] Negligible.

III. WATER SUPPLY

A. PRESENT SOURCES

1. FEDERAL CENTRAL VALLEY PROJECT

The principal source of high-quality water supplies for municipal, industrial, and agricultural uses within the District is the Contra Costa Canal system. This facility, the first operational unit of the Federal Central Valley Project, was constructed and is presently operated by the United States Bureau of Reclamation. Construction of the Canal system began in 1937, but all features were not completed until 1948. Water was first delivered from the Canal in 1940.

The intake to the Contra Costa Canal is through an unlined section four miles in length leading from Rock Slough, a natural channel of the Sacramento-San Joaquin Delta. Water supplies are lifted by a series of four pumping plants from the intake channel through a total of some 120 feet to the beginning of the lined gravity-flow section, from which point the Canal follows the base of a range of low hills in a generally westerly direction to Port Chicago. At Port Chicago, the Canal turns southward and loops around the Diablo Valley, passing through the cities of Concord, Walnut Creek, and Pleasant Hill, and terminating in Martinez Reservoir.

Other canals in the system are the Clayton and Ygnacio Relift Canals. Water is pumped into these canals from the main Contra Costa Canal to serve higher lands in the Clayton and Ygnacio Valleys. The locations of the various features of the Contra Costa Canal system are shown on Plate 5.

The historical use of water from the Contra Costa Canal system from 1956 through 1967 is summarized in Table 11. A graphic representation of sales from the Canal in calendar year 1964, a typical year, is shown on Plate 5.

TABLE 11

HISTORICAL WATER USE FROM CONTRA COSTA CANAL

Acre Feet

	Deliveries				
Year	Municipal	Industrial	Agricultural	Unaccounted-for Water	Total Diversions
1956	16,681	19,716	5,057	3,728	45,182
1957	20,395	24,020	5,751	3,670	53,836
1958	17,410	25,609	3,744	3,700	50,463
1959	25,686	32,628	5,968	6,996	71,278
1960	24,200	39,832	5,309	7,712	77,053
1961	25,736	41,023	7,291	5,173	79,223
1962	21,855	32,974	6,687	4,560	66,076
1963	20,351	32,944	4,651	5,229	63,175
1964	31,274	43,050	6,737	5,513	86,574
1965	24,390	34,662	4,864	6,168	70,084
1966	32,916	42,831	5,867	6,703	88,317
1967	25,751	36,209	4,715	2,941	69,616

Source: Contra Costa County Water District data.

The present water supply contract between the District and the United States Bureau of Reclamation, Contract I 75r-3401, dated 18 September 1951, provides that the District may purchase up to 86,000 acre feet annually, excluding system losses, through the Contra Costa Canal system. As can be seen from Table 11, the total District demands on the Canal have almost reached this amount in some recent years. There is no guarantee that the Bureau will sell the District more than the contracted amount in any year, and in fact, it is unlikely that the present Federal Central Valley Project would have any excess supplies available during a period of very low water supply such as was experienced from 1959 through 1961.

2. SACRAMENTO-SAN JOAQUIN DELTA

Although the Rock Slough intake to the Contra Costa Canal system is a feature of the Sacramento-San Joaquin Delta, that source of supply to the District has been treated separately throughout this Report. The remainder of the Delta supply is described below.

The Sacramento and San Joaquin Rivers, draining the Central Valley of California, join along the northern boundary of the District near Pittsburg. From this point the waters flow through Honker Bay, Suisun Bay, and the Carquinez Straits into San Pablo and San Francisco Bay, and finally through the Golden Gate into the Pacific Ocean. During certain times of the year, these offshore waters create a source of supply to several of the District's major customers.

The reach of this waterway adjacent to the District from Antioch to Nichols is an area of seasonally varying water quality, as measured by the chloride ion concentration. During the winter and spring months, flood flows from the Rivers predominate and the offshore waters in this reach have been generally low in chlorides, being suitable for municipal and industrial purposes. During the summer and autumn months, River flows are low and saline waters from the ocean are able to intrude far into the Delta. During this season, the quality of the offshore waters from Antioch to Nichols has in most recent years been suitable only for cooling supplies in industrial plants which are especially equipped to use high-chloride waters for that purpose. In addition to this seasonal variation, there are daily variations in offshore water quality due to tidal effects.

The number of days in any year in which the quality of the offshore waters is suitable for municipal and industrial purposes is generally termed the "period of availability." This period varies from year to year, being primarily dependent on the amount of rainfall and snowmelt occurring in the Central Valley during the winter months. In years of "wet" hydrologic conditions in the Central Valley, the spring runoff extends into May or June, and the period of availability is correspondingly long. Conversely, under "dry" hydrologic conditions the flood runoffs cease early and the period of availability is short. Under "median" conditions of water supply in the Central Valley, the period of availability of water having a chloride ion content of 100 ppm or less has historically amounted to 182 days annually at Antioch.

Besides the general variation in the period of availability offshore caused by the water supply conditions in the Central Valley, there is a geographic variation from west to east due to the extent of intrusion of ocean waters. Areas in the eastern part of the Antioch-to-Nichols reach have had a longer period of availability in any given year than areas in the western part. For example, the period at Mallard Slough has historically been only 142 days per year under "median" water supply conditions, in comparison to the 182 days for Antioch.

At the present time, a number of industries located along the shore within the District obtain a portion or all of their high-quality process water supply from the Sacramento and San Joaquin Rivers whenever the quality is suitable. In addition, two municipal water supply distributors, the City of Antioch and the Treated Water Division of the District, divert water from offshore when it is available in suitable quality.

The estimated production of offshore water supplies for use within the District from 1956 through 1966 is summarized in Table 12. Although a maximum chloride ion concentration of 100 ppm has been used in the examples given above, suitable quality water for any particular user may under certain circumstances contain up to 250 ppm chlorides, depending on the customer's

TABLE 12

HISTOPICAL WATER DIVERSIONS FROM SACRAMENTO-SAN JOAQUIN DELTA FOR USE WITHIN DISTRICT[a]

Acre Feet

Year	Municipal and Industrial Process Water[b]	Industrial Cooling Water[c]	Total (Rounded)
1956	26,331	1,018,000	1,044,000
1957	27,573	1,184,000	1,212,000
1958	36,662	1,052,000	1,089,000
1959	26,930	1,143,000	1,170,000
1960	20,110	1,393,000	1,413,000
1961	25,802	1,569,000	1,595,000
1962	33,136	1,484,000	1,517,000
1963	32,979	1,423,000	1,456,000
1964	30,160	1,500,000[d]	1,530,000
1965	50,346	1,500,000[d]	1,550,000
1966	33,000[d]	1,500,000[d]	1,533,000

a/ Exclusive of deliveries from Contra Costa Canal.

b/ High-quality water.

c/ No quality limitations.

d/ Estimated.

Source: Contra Costa County Water District data.

individual process requirements, the availability of better-quality water for mixing, and similar factors. Water of not more than 100 to 150 ppm chlorides, however, make up the bulk of the high-quality diversions shown in Table 12.

Water supplies from the Sacramento-San Joaquin Delta are also used for irrigation purposes in the East Contra Costa Irrigation District (ECCID) and the Byron-Bethany Irrigation District (BBID), generally in the Brentwood and Byron sub-areas. Supplies are pumped to inland areas, or are siphoned to lands located immediately adjacent to Delta channels. The ECCID pumping station is located on Indian Slough, and delivers about 35,000 acre feet annually. The BBID diverts about 40,000 acre feet annually through its pump intake on Italian Slough.

Diversions of Delta water for irrigation uses in the Islands sub-area are made by siphoning directly from the adjacent Delta channels.

3. GROUND WATER

Ground water is not a significant source of water supply within the District, although it is substantially the only source for some uses in those portions of the study area lying outside the District boundaries.

The District's Treated Water Division until recently operated 23 wells in four well fields, using them principally during periods of peak demand. Use of these wells has been discontinued, since the quality of the ground water was generally very poor for municipal uses. There are a number of other wells in private ownership within the TWD service area; their total annual production is not definitely known but is very small. A few industries in the study area produce a small portion of their total water supply from their own wells.

The average quality of ground water supplies in the Diablo Valley basin ranges from 450 to 2,000 ppm total dissolved solids. Although the safe annual yield of the basin has been estimated by the Bureau of Reclamation at about 5,000 acre feet, only a fraction of this yield is withdrawn, primarily because of the poor quality of the supply.

Within the Byron, Brentwood, and Islands subareas, ground water is the main source of domestic water supply, and is also developed to some extent for irrigation purposes. The towns of Byron and Brentwood operate municipal distribution systems supplied from ground water. No treatment is provided. Available chemical analyses of samples from the Brentwood wells indicate that the ground water in this area is very poor for municipal uses, having a total hardness of about 400 ppm and total dissolved solids of about 800 ppm.

B. FUTURE SOURCES

1. FEDERAL CENTRAL VALLEY PROJECT

a. Contra Costa Canal Unit. As is discussed in detail in Section VI-A.1, the existing Contra Costa Canal system, even under present conditions, is not able at all times to provide water supplies having the requisite quality for the municipal and industrial uses to which it is put. If the joint Federal-State Peripheral Canal, serving the Federal Central Valley Project and the State Water Project, is constructed as now planned, it is probable that in many future years only sufficient fresh water from the Sacramento River will be released into the channels of the Delta to maintain water qualities adequate for agricultural uses during the growing season. Under these circumstances, the Rock Slough intake to the Contra Costa Canal system will not be able to provide a firm supply of even minimum quality water for municipalities and industries in the study area.

As will be shown subsequently in Section VI-A, the design capacity of the Contra Costa Canal is rapidly being approached, and the Canal will require substantial modification if it is to continue to function as a part of the supply system serving the District. Furthermore, the 86,000 acre feet per annum contracted for by the District under the original Contra Costa Canal Unit service contract is now all required to meet the District's needs, and an additional supply must be provided from the Federal Central Valley Project or some alternate source at an early date.

b. Kellogg Unit. In recognition of the present unsatisfactory nature of the Rock Slough source for the Contra Costa Canal system, and of the fact that the intake will shortly be rendered almost totally worthless by upstream developments causing deterioration of water quality in the Western Delta channels, the United States Bureau of Reclamation has proposed the so-called Kellogg Unit of the Federal Central Valley Project to provide a firm, high-quality water supply to the District. The proposed Kellogg Unit is described in detail in reference 5, and a plan of the Unit is shown herein on Plate 6.

Water supply for the Kellogg Unit would be drawn from the existing Tracy Pumping Plant intake channel, and would be pumped through a new Tracy II Pumping Plant having 800 cfs capacity. From the discharge of this plant, water would be able to flow either into the existing Delta-Mendota Canal or through the proposed Tuway Canal into Herdlyn Reservoir. The Tuway Canal would have a capacity of 800 cfs, and would be designed so that this flow could be conveyed in either direction. The proposed Herdlyn Reservoir would have a storage capacity of 1,870 acre feet, and would serve as a pumping forebay from which water supplies would be delivered into Kellogg Reservoir.

The proposed 800 cfs Kellogg Pumping-Generating Plant would lift water from Herdlyn Reservoir into Kellogg Reservoir, and would also be capable of generating power from flows released back from Kellogg Reservoir, through Herdlyn Reservoir and the Tuway Canal, and into the existing Delta-Mendota Canal.

The proposed Kellogg Reservoir would have a total storage capacity of 135,000 acre feet, including an 8,000 acre foot seasonal flood control reservation. A normal minimum operational pool of 50,000 acre feet would be maintained for system reliability, water quality control, and fish, wildlife, and recreation purposes. The reservoir would be impounded by a main earthfill dam 170 feet in height, and ten supplemental saddle dikes.

From Kellogg Reservoir, water would flow by gravity through the proposed Contra Loma Canal to the recently-completed Contra Loma Reservoir. From a point on this Canal about four miles upstream from Contra Loma Reservoir, the proposed Laurel Canal would take off and connect to the existing Contra Costa Canal at Pumping Plant No. 4. This branch would be able to deliver water into the Contra Costa Canal both upstream and downstream of the pumping plant. Contra Loma Canal would have a capacity ranging from 1,000 to 600 cfs, while the capacity of the Laurel Canal would be 300 cfs at the beginning and 225 cfs at the end. These capacities may be increased during final design studies.

According to the Bureau's plan of operation, the quality of water supplies delivered to the District from the Federal Central Valley Project would be controlled by pumping from the Tracy intake channel when the water at that point is of requisite quality for municipal and industrial purposes, and storing this water in Kellogg Reservoir. This good quality water would subsequently be released through the Contra Loma Canal into the District's service area for use when the quality of water in the Delta at Rock Slough is unsatisfactory. At times when the water quality at Rock Slough is satisfactory, the Bureau plans to divert supplies from that source through the four main pumping plants.

According to the Bureau's operation studies, the proposed Kellogg Unit could be operated to provide the District with up to 440,000 acre feet annually of water having 100 ppm or less chlorides. However, a total of only 195,000 acre feet is presently allocated to the District's service area from the existing Federal Central Valley Project, including the 86,000 acre feet now committed under Contract I 75r-3401. Development of the incremental 245,000 acre feet would require enlargement of the Central Valley Project through provision of additional storage, and acquisition of the water rights necessary to such enlargement by the United States.

The proposed Kellogg Unit would provide substantial benefits to the Central Valley Project as a whole. The yield of the Project would be augmented by increasing the ability to capture surplus flows in the Delta. The ability to feed back by gravity from Kellogg Reservoir into the Delta-Mendota Canal and to feed direct from the Tracy II Pumping Plant into the Canal would greatly increase the reliability of the Bureau's system, and would obviate the need to provide standby pumping capacity at the existing Tracy Pumping Plant. Finally, the provision of pumping-generating units at the proposed Kellogg Pumping-Generating Plant would permit water to be pumped into Kellogg Reservoir during off-peak hours and released back through the plant during peak hours when the value of the power thus generated would be very high. Significant power benefits could be developed for the Central Valley Project by such operation.

In addition to providing a firm supply of high-quality water, the proposed Kellogg Unit would bring a high degree of reliability to the system serving the District due to the ability to provide a gravity supply throughout the service area in case of a power outage or a breakdown of one of the pumping units. Other general benefits created by the Unit would include flood control, fish and wildlife enhancement, and the provision of outstanding water-associated recreational opportunities.

2. SACRAMENTO-SAN JOAQUIN DELTA

It is anticipated that the number of days of availability of high-quality water supply in the Sacramento-San Joaquin Delta between Antioch and Nichols will be fewer in the future for any given hydrologic condition in the Central Valley than has been the case in the past. Some water will continue to be available, however, for all but very dry conditions.

The projected availability of high-quality water in the Sacramento-San Joaquin Delta at Mallard Slough and at Antioch is shown in Table 13, based on data obtained from the State of California, Department of Water Resources. These projections were obtained from studies conducted by the Department to estimate the effect of the combined operation of the State Water Project and the Federal Central Valley Project on the water resources of the State. In these studies, the historical hydrologic conditions of the 33-year period 1922 through 1954 were assumed to be repeated in the future. In Table 13, the terms "wet" and "dry" refer to conditions of hydrology that occurred in the wettest and driest years during this 33-year period, 1938 and 1931 respectively. "Median" refers to the median hydrologic condition in the period, which occurred in 1936.

The reduction in availability of the offshore water supply indicated in Table 13 will be caused by increasing upstream uses of the waters of the Sacramento and San Joaquin Rivers. One of the largest such users will be the State of California through the State Water Project, which will ultimately divert beyond the Delta some four million acre feet annually which otherwise would have flowed past Pittsburg. With the completion

TABLE 13

PROJECTED AVAILABILITY OF HIGH-QUALITY OFFSHORE WATER[a]

Days per Year[a]

Location and Hydraulic Condition	1980	1990	2000	2010	2020
Mallard Slough					
Wet	190	170	168	166	165
Median	70	60	55	53	52
Dry	0	0	0	0	0
Antioch					
Wet	205	198	195	194	193
Median	114	107	102	98	95
Dry	0	0	0	0	0

[a] Anticipated number of days per year in which water having a chloride ion concentration equal to or less than 100 ppm averaged over the tidal cycle will be available at the location shown.

Source: State of California, Department of Water Resources.

of the San Luis Unit of the Federal Central Valley Project in 1967, the United States Bureau of Reclamation will now divert more water from the Delta than it has historically. These diversions will increase still further on completion of the proposed East Side Division of the Project.

The Department of Water Resources has agreed to provide monetary compensation to the District for its contribution to the reduction in the offshore availability at Mallard Slough, and is presently negotiating similar agreements with other offshore users. However, the agreement between the District and the Department assumes that the District will be able to purchase substitute water from the Federal Central Valley Project, with delivery through the Contra Costa Canal system supplemented by the proposed Kellogg Unit. This cannot be accomplished for more than possibly a few more years under the District's present water supply contract and with the capacity limitations of the existing Canal system, discussed subsequently in Section VI-A.

Under future conditions, with the Federal Central Valley Project and the State Water Project in full operation, high-quality water supplies will be available at all times only in the southeastern part of the study area, at the Clifton Court Forebay and at the intake to the Tracy Pumping Plant. Water of quality desirable for municipal purposes must be provided at Clifton Court in order for the State to maintain its contractual commitments to State Water Project water service contractors. In order to meet these commitments and to minimize the detrimental effects of their export projects on the Delta, the State and the United States Bureau of Reclamation plan to construct the Peripheral Canal. This facility would divert fresh water flows of the Sacramento River around the eastern edge of the Delta for delivery at Clifton Court. The Peripheral Canal would be hydraulically separated from the Delta, but releases of fresh water could be made to the Delta channels at certain points.

3. POSSIBLE DISTRICT-SPONSORED PROJECTS

There are several alternatives to the proposed Kellogg Unit which are now being studied for possible District sponsorship. One of these in particular appears to hold promise of providing for the District's needs at a unit water cost comparable to, and possibly lower than, the anticipated cost of water to the District from Kellogg. A preliminary report on this project, the Los Vaqueros Project, will be prepared in the near future.

Sources of water supply for the Los Vaqueros Project would be limited to either the Federal Central Valley Project or the State Water Project, or both. The District could continue to take the 86,000 acre feet which it now has available to it from the CVP by contract through December 31, 1991. In addition, it is probable that the District could obtain from the CVP the full 195,000 acre feet allocated for use in its service area, and possibly additional supplies beyond that amount if the yield of the CVP is augmented in the future by the addition of new storage units. These supplies would be taken from the Delta in the vicinity of Clifton Court Forebay and the Tracy Pumping Plant. It would be desirable, from the standpoint of economy, if the supplies could be pumped through the State's Delta Pumping Plant and into the California Aqueduct, from which point they would be diverted into the District's canal serving the Los Vaqueros Project. However, the supplies could if necessary be pumped directly through a new pumping plant constructed by the District.

As an alternative, the water supply for the Los Vaqueros Project could be obtained from the State Water Project, being diverted from the California Aqueduct just downstream of the outlet works of the Delta Pumping Plant. By law, the District has a right to purchase all the water from the State Water Project which it reasonably needs for its full economic development.

4. GROUND WATER

Ground water is not expected to be a significant source of water supply to the study area in the future. The principal use of ground water at the present time is for domestic purposes in certain areas outside the District which now have no alternative source of supply. As alternative sources are made available in the future, it is probable that the use of ground water will be discontinued.

5. WASTE WATER RECLAMATION

Municipal and industrial waste waters occurring within the study area are treated and discharged to the Sacramento-San Joaquin Delta and Suisun Bay in accordance with requirements promulgated by the Central Valley and San Francisco Bay Regional Water Quality Control Boards. The possiblities for re-use of some of these waste waters for certain industrial purposes presents the potential for increasing the firm water supply available to the District at reasonable cost, for reducing the cost of water to the industries and the cost of treatment to the waste dischargers, and for increasing the availability of fresh water supplies in the Delta for economic benefit to other areas of the State.

The traditional procedure for evaluation of waste waters as a source of water supply has been to determine the cost of treating the wastes to the degree necessary to meet the quality and public safety criteria required by the potential uses, and then to compare this cost with that of procuring an alternative fresh water supply. Where treatment costs for ordinary disposal are low, the increased costs to upgrade the wastes to usable quality can be very high in comparison to the cost of new water from the alternative source. In the study area, however, it is probable that the requirements for collection and treatment of wastes prior to disposal in the San Francisco Bay-Delta system will be substantially increased in the near future, with an attendant increase in the costs of treatment. Under these circumstances, a waste water reclamation system could result in over-all savings to both the waste dischargers and the industries utilizing the reclaimed water. Some contribution might also be sought from the State, since such re-use of waste waters would make the alternative fresh water supply available to benefit others. Low-interest financing for waste water reclamation projects is now available from the State to qualifying agencies. Some Federal assistance may also be possible.

A particularly good opportunity for waste water reclamation appears to exist in the Central County and Martinez sub-areas. The effluent of the Central Contra Costa Sanitary District sewage treatment plant is anticipated to be sufficient in quantity to meet most of the future water requirements of petroleum refining industries in those sub-areas, and has a mineral quality comparable to that of the District's present raw water supplies developed at Rock Slough. This is because the source water supply for a significant portion of the area tributary to the Sanitary District's plant is the East Bay Municipal Utility District system. The treatment plant is located near the industries so that the cost of transmission would be small. A study of the feasibility of reclamation and use of the effluent from this treatment plant should be undertaken in the near future.

6. SALINE WATER CONVERSION

Desalting of the brackish offshore waters of the Sacramento-San Joaquin Delta and Suisun Bay presents the potential for an unlimited source of water for municipal and industrial use in the study area, although it is not now economically competitive with imported fresh water supplies. Present estimates of the cost of desalting brackish water with a plant having 100 mgd capacity are in the order of $70 to $90 per acre foot at the plant, the actual cost being dependent on the salinity of the source water, the cost of power, and a number of other factors. By comparison, as is stated in Section IX-B, the estimated cost of fresh water from the proposed Kellogg Unit is about $20 per acre foot at Contra Loma Reservoir. However, the cost of desalted water is certain to decrease in the future as the technology of this new field advances, while the cost of imported water is equally certain to increase as sources further and further from the demand area are developed. In the long view, brackish offshore waters could well be the next source of supply to be developed after the full yield of the Kellogg Unit is utilized, and after the potential for waste water reclamation has been fully exploited.

IV. WATER REQUIREMENTS

A. MUNICIPAL

1. RESIDENTIAL

Future residential water requirements in the study area were estimated following the method developed recently at The Johns Hopkins University, with only minor modifications. This method, described in a publication entitled "Residential Water Use Research Project," reference 6, differentiates between in-house domestic use and lawn sprinkling use and thus permits a recognition of the wide variation in unit "per-capita" use values between areas having low and high densities of dwelling units. In general, in-house domestic use is fairly uniform, with low density (or relatively higher value) units using perhaps 25 per cent more water than high density units. On the other hand, homes in low density areas typically use from three to four or more times as much water for lawn sprinkling purposes as do homes in high density areas.

In applying the Johns Hopkins procedure, a check was first made against known use in study sub-areas where records are good. These checks generally showed a remarkably close correspondence. For example, the Johns Hopkins procedure applied to the known 1962 residential density patterns in the Central County sub-area (practically the same as the present TWD service area) resulted in a computed over-all unit use of 95 gallons per capita per day(gpcd), whereas the measured residential use within TWD in 1962, including canal sales to groups and associations, amounted to about 92 gpcd.

Over-all unit per-capita use factors were then determined for each sub-area for 1962 based on the known residential density patterns, and for 1985 based on the County Planning Commission's land use and circulation plan. Between 1962 and 1985, in-house domestic use was assumed to increase at the rate of 2 per cent annually, while lawn sprinkling was assumed to remain constant. Per-capital use factors were interpolated between the 1962 and 1985 values for the intervening years. For use beyond 1985, the factors were extrapolated considering a 1 per cent annual increase in in-house use to the year 2000 and constant thereafter, and constant values for lawn sprinkling use. Per-capita use factors computed in this manner were applied to anticipated future population to obtain estimated future residential water requirements in each sub-area.

2. COMMERCIAL AND PUBLIC

Commercial and public water requirements were estimated for each sub-area for the years 1962 and 1985, based on areas devoted to such uses and applying unit water demands per acre. Unit demand values adopted for this purpose are summarized in Table 14. Those for 1962 were derived from actual use records for that year, while the 1985 values shown represent future "ultimate" values commonly used for planning purposes. The 1962 values shown in Table 14 are considered to be somewhat low for many of the categories, since they were derived by dividing recorded use by total area without consideration of the fact that in some cases portions of the areas received no water at all.

Total commercial and public requirements derived as above for 1962 and 1985 were divided by population to obtain per-capita values for the two years for each sub-area. Requirements for the intervening years were estimated by applying interpolated per-capita values to population estimates. Requirements beyond 1985 were obtained by multiplying projected future population by the 1985 value of per-capita demand, since the 1985 duties were considered to be maximum values.

3. LOSSES

Water losses in municipal systems were taken as 13 per cent of the total of residential plus commercial and public requirements for all sub-areas except Central County, for which the loss factors were those used in the Montgomery report, reference 7.

TABLE 14

DUTY OF WATER FOR COMMERCIAL AND PUBLIC AREAS

Acre Feet per Acre per Year

	1962[a]	1985[b]
Commercial	1.2	3.0
Public:		
Airports and Fairgrounds	0.2	0.4
Colleges	0.5	1.0
Public Green Areas[c]	1.2	3.0
Schools and Churches	0.5	1.0
Playgrounds and Local Parks	0.6	2.0

[a] Source: Contra Costa County Water District data.

[b] Estimated (ultimate values).

[c] Golf courses, cemeteries, regional parks, etc.

TABLE 15

PROJECTED MUNICIPAL WATER REQUIREMENTS[a]

Acre Feet per Year

Area	1970	1980	1990	2000	2010	2020
Martinez	3,800	7,200	12,800	20,100	25,800	29,700
Central County	26,800	43,400	60,800	78,400	91,400	100,500
Nichols	1,600	2,800	4,300	5,700	6,400	6,900
Pittsburg	4,500	7,500	10,700	13,500	15,100	16,200
Antioch	4,100	11,300	18,100	25,100	29,800	34,000
Oakley	500	1,700	3,300	5,100	6,300	7,000
Sub-total CCCWD Service Area	41,300	73,900	110,000	147,900	174,800	194,300
Islands	700	3,000	6,900	11,000	13,400	15,200
Brentwood	1,900	3,800	7,800	16,000	27,300	40,800
Byron	300	1,100	4,100	11,000	21,600	36,800
Total Study Area	44,200	81,800	128,800	185,900	237,100	287,100

[a] Does not include requirements of the Nortonville-Somersville or Mt. Diablo-Los Meganos sub-areas, which are negligible.

4. TOTAL MUNICIPAL REQUIREMENTS

Total municipal water requirements estimated by the foregoing methods are summarized by decades in Table 15.

B. INDUSTRIAL

1. METHODOLOGY

As a first step in predicting future high-quality industrial water requirements in the study area, a comprehensive survey was conducted of industries within the District which now use or could require raw water supplies. "High-quality" water is that having a chloride ion content sufficiently low as to be suitable for the process requirements of the various industries. This survey obtained current information on land usage, employment, storage facilities, degree of recirculation, and peaking requirements as well as historical water usage from 1964 through 1966, and each industry's estimate of its water needs in 1970 and 1980. Reported historical water usage encompassed supplies having a chloride ion content up to a maximum of 250 ppm, although most of the "high-quality" water contained not more than 100 to 150 ppm chlorides. These data, and data obtained from a similar survey in 1963, provided the basis for projecting future requirements.

In the survey, it was found that the recorded intake of high-quality water by the District's major industrial customers represents only about 17 per cent of the total gross water requirement of those industries. This rate of recirculation is well above the national average. Were it not for this high degree of water conservation, water requirements within the District would be much higher than they are at present. For instance, with no recirculation, industrial requirements for high-quality water would have amounted to more than 250,000 acre feet in 1966.

For convenience in analyzing the results of this survey and in making projections, the industries were grouped according to the United States Bureau of the Budget Standard Industrial Classification (SIC) system. It was found that 98.8 per cent of the total high-quality industrial water requirement within the study area at present is used by industries falling into the following five major SIC categories:

Group 20 - Food and Kindred Products
Group 26 - Paper and Allied Products
Group 28 - Chemicals and Allied Products
Group 29 - Petroleum Refining and Related Industries
Group 33 - Primary Metal Industries

An extensive review of the literature and reports on industrial growth and water use was carried out. The most important single source of this type of information is Committee Print No. 9, "Future Water Requirements of Principal Water-Using Industries," prepared by the United States Senate Select Committee on National Water Resources in 1960, reference 8. The Select Committee investigation, now being updated in certain aspects, is the most thorough study of its type ever undertaken, projecting national and regional water requirements on a co-ordinated economic basis. Anticipated growth trends are presented for the major SIC categories, nationally, regionally, and for certain metropolitan areas, to the year 2000.

A number of interviews were conducted with the management of the larger industrial water users in the District, which produced important information for use as a guide in the selection and adjustment of trends of water requirements.

The basic procedure followed in developing water requirement projections for the five major SIC groups was first to plot the historical use and establish a trend line. In carrying the historical trend forward to the year 1980, substantial weight was given to the projections made by the individual industries for their own water requirements. Projections beyond 1980 were based on historic trends and changes in trend patterns predicted in reference 8.

It is recognized that the technology of industrial water supply and the economics of water use are changing rapidly, and that the factors affecting the choice of location for industrial growth are also varying, so that projections of industrial water requirements 50 years into the future can be regarded as no more than indicators. Nevertheless, such projections must be made and must be as rational as possible in view of the long-range nature of the major water resource development projects which will be undertaken to satisfy those requirements.

2. PROJECTED REQUIREMENTS

The historical and projected industrial water requirements for the major industrial groups, as estimated by the foregoing procedures, are summarized in Table 16.

In order to obtain an estimate of the total industrial high-quality raw water requirement in the study area, an increment was added to account for uses not falling within the five major SIC groups previously listed. This increment represents water supply to smaller satellite industries which supplement the basic industries. In a fully-developed industrial community, the total of these smaller uses normally amounts to about 10 per cent of the total of all uses. At the present time in the District, the amount is only about 1.1 per cent. It was assumed that this percentage would increase steadily with time, reaching 10 per cent by the year 2010, as shown in Table 16.

3. DISTRIBUTION OF REQUIREMENTS

The distribution of anticipated industrial high-quality water requirements to the various sub-areas was made considering the existing locations of industries and the location of lands available for industrial development. This distribution is summarized in Table 17.

TABLE 16

HISTORICAL AND PROJECTED HIGH-QUALITY INDUSTRIAL WATER REQUIREMENTS

Thousands of Acre Feet per Year

Year	5 Major SIC Groups	Other Industrial Requirements: % of Major SIC Groups	Other Industrial Requirements: Total	Total Requirements
1960	58.7	.85	.5	59.2
1964	67.1	1.19	.8	67.9
1965	68.5	1.17	.8	69.3
1966	72.8	1.10	.8	73.6
1970	93.6	2.5	2.4	96.0
1980	122.2	3.0	3.5	125.7
1990	149.0	5.5	8.0	157.0
2000	176.5	8.0	13.7	190.2
2010	204.5	10.0	20.9	225.4
2020	231.2	10.0	23.6	254.8

Note: Historical information shown above developed from Contra Costa County Water District records.

TABLE 17

DISTRIBUTION OF HIGH-QUALITY INDUSTRIAL WATER REQUIREMENTS

Thousands of Acre Feet per Year

Area	1970	1980	1990	2000	2010	2020
Martinez	14.8	22.9	26.5	30.4	33.8	37.2
Central County	19.2	24.3	28.8	34.0	39.2	43.2
Nichols	3.5	7.3	9.6	12.5	16.3	19.5
Pittsburg	16.2	18.9	21.7	24.4	27.3	29.6
Antioch	40.0	47.7	64.3	81.7	100.1	115.7
Oakley	2.3	4.6	6.0	7.1	8.5	9.4
Sub-total CCCWD Service Area	96.0	125.7	156.9	190.1	225.2	254.6
Islands	0	0	0	0	0	0
Brentwood	0	0	0.1	0.1	0.2	0.2
Byron	0	0	0	0	0	0
Total Study Area	96.0	125.7	157.0	190.2	225.4	254.8

C. AGRICULTURAL

Estimates of future agricultural water requirements within the study area prepared by the United States Bureau of Reclamation were accepted for use in this study, and were distributed between sub-areas based on current use data. These requirements are summarized in Table 18. The projection of future agricultural requirements did not include the portions of the Brentwood and Byron sub-areas now served by the East Contra Costa Irrigation District and the Byron-Bethany Irrigation District, respectively, since it was assumed that these agencies would continue to meet demands for agricultural water within their service areas. Also, the projection of future requirements excluded areas which can readily be served by individual pumping directly from the Delta channels.

The principal agricultural demand which is anticipated within the District would be that of the Lone Tree-Deer Valley service area of the proposed Kellogg Unit. The additional area which the Bureau of Reclamation proposes to irrigate from the Kellogg Unit is shown on Plate 6. Although there is some question as to the likelihood of this area actually being devoted to agricultural purposes in the future, the Bureau's estimate of water needs in the area were accepted for study purposes, since the needs would be practically the same even if the area is eventually developed for residential purposes. The total demand in the Lone Tree-Deer Valley area was distributed between the Antioch and Brentwood sub-areas in proportion to its area lying within each.

D. TOTAL WATER REQUIREMENTS

1. TOTAL REQUIREMENTS

A summary of the projected total high-quality water requirements to the year 2020 is shown in Table 19, for the study area and within the present District boundaries. These requirements are shown graphically on Plates 7 and 8.

TABLE 18

PROJECTED AGRICULTURAL WATER REQUIREMENTS[a]

Acre Feet per Year

Area[b]	1970	1980	1990	2000	2010	2020
Central County	1,500	0	0	0	0	0
Antioch	800	3,300	4,800	4,600	4,600	4,600
Oakley	2,000	900	400	0	0	0
Sub-total CCCWD Service Area[c]	4,300	4,200	5,200	4,600	4,600	4,600
Brentwood	1,800	12,500	18,800	18,400	18,400	18,400
Total Study Area	6,100	16,600	24,000	23,000	23,000	23,000

a/ Does not include the agricultural water requirements of:

1. The portion of the Brentwood sub-area served by the East Contra Costa Irrigation District.
2. The Byron sub-area, which is served by the Byron-Bethany Irrigation District in the western portion and irrigated by individual pumping from the Delta in the eastern portion.
3. The Islands sub-area, which is irrigated by individual pumping from the Delta.

b/ There is no anticipated agricultural use in the Martinez, Nichols, Pittsburg, Nortonville-Somersville, Mt. Diablo-Los Meganos sub-areas.

c/ Excluding the portion of the Lone Tree-Deer Valley lying within the Brentwood sub-area.

TABLE 19

PROJECTED TOTAL HIGH-QUALITY WATER REQUIREMENTS

Thousands of Acre Feet per Year

	1970	1980	1990	2000	2010	2020
Present CCCWD Service Area:						
Municipal	41.3	73.9	110.0	147.9	174.8	194.3
Industrial	96.0	125.7	156.9	190.1	225.2	254.6
Agricultural[a]	4.3	4.2	5.2	4.6	4.6	4.6
Total	141.6	203.8	272.1	342.6	404.6	453.5
Total Study Area:						
Municipal	44.2	81.8	128.8	185.9	237.1	287.1
Industrial	96.0	125.7	157.0	190.2	225.4	254.8
Agricultural	6.1	16.6	24.0	23.0	23.0	23.0
Total	146.3	224.1	309.8	399.1	485.5	564.9

[a] Excludes Lone Tree-Deer Valley agricultural demands in Brentwood sub-area.

2. REQUIREMENTS ON SUPPLY SYSTEM

As was discussed previously in Section III-B.2, it is anticipated that the availability of high-quality water supplies in the Sacramento-San Joaquin Delta between Antioch and Nichols will be less in the future than it has been in the past. As a result, it is possible that some of the present users of the offshore supply, including the City of Antioch, may cease to use their offshore diversion facilities in the future, taking their full supplies, including replacement water for their offshore entitlement, from the Contra Costa Canal. New industries locating in the District will probably not construct offshore production facilities for high-quality water. The District's Treated Water Division is expected to continue to pump with its Mallard Slough facilities when high-quality water is available offshore, because of the fairly large storage capacity of Mallard Reservoir and because of the low cost of pumping into this low-elevation facility.

The effect of this reduction in the availability and use of offshore water supplies will be to place an increasing proportion of the total annual water requirement on the overland supply system, which will include the Contra Costa Canal system and the Kellogg Unit. The projected future diversions of high-quality water from the Sacramento-San Joaquin Delta for use within the study area are listed in Table 20. These diversions were estimated considering the factors discussed in the preceding paragraph and the anticipated future availability of high-quality water at various points between Nichols and Oakly. These latter data were based on estimates made by the Department of Water Resources and summarized in Table 13.

The balance of the total District and study area water requirements, except for certain agricultural needs to be provided for by other agencies, is shown in Tables 21 and 22. These requirements must be provided through the overland supply system. An additive of 5 per cent of the net requirements listed in Tables 21 and 22 was included to allow for unavoidable losses in the system. After construction of the Peripheral Canal, the entire annual study area requirement except for the agricultural uses mentioned above, must be provided through the overland supply system during dry hydrologic conditions in the Central Valley. The projected demand within the present District service area for high-quality water from the overland supply system, including losses, is shown on Plate 9 for wet, median and dry conditions in the Valley.

TABLE 20

PROJECTED HIGH-QUALITY WATER DIVERSIONS FROM SACRAMENTO-SAN JOAQUIN DELTA FOR USE IN STUDY AREA a/

Thousands of Acre Feet per Year

Year	Hydrologic Condition	Municipal	Industrial	Total
1970	Wet	21.0	37.7	58.7
	Median	11.5	29.2	40.7
	Dry	1.4	17.8	19.2
1980	Wet	28.3	24.2	52.5
	Median	12.8	13.3	26.1
	Dry	0	0	0
1990	Wet	30.7	29.2	59.9
	Median	12.9	17.3	30.2
	Dry	0	0	0
2000	Wet	38.0	38.4	76.4
	Median	14.4	19.0	33.4
	Dry	0	0	0
2010	Wet	44.5	45.9	90.4
	Median	16.9	23.0	39.9
	Dry	0	0	0
2020	Wet	50.6	52.9	103.5
	Median	18.7	25.6	44.3
	Dry	0	0	0

a/ Excludes diversions from Rock Slough and diversions for irrigation in areas served by East Contra Costa and Byron-Bethany Irrigation Districts and by individual pumping from Delta channels.

TABLE 21

PROJECTED DEMAND ON SUPPLY SYSTEM FOR WATER IN PRESENT DISTRICT SERVICE AREA[a/]

Thousands of Acre Feet per Year

Year	Hydro-logic Condition	Municipal	Industrial	Agricul-tural	Sub-Total	Losses	Total
1970	Wet	20.3	58.3	4.3	82.9	4.2	87.1
	Median	29.8	66.8	4.3	100.9	5.1	106.0
	Dry	39.9	78.2	4.3	122.4	6.1	128.5
1980	Wet	45.6	101.5	4.2	151.3	7.6	158.9
	Median	61.1	112.4	4.2	177.7	8.9	186.6
	Dry	73.9	125.7	4.2	203.8	10.2	214.0
1990	Wet	79.3	127.7	5.2	212.2	10.6	222.8
	Median	97.1	139.6	5.2	241.9	12.1	254.0
	Dry	110.0	156.9	5.2	272.1	13.6	285.7
2000	Wet	109.9	151.7	4.6	266.2	13.3	279.5
	Median	133.5	171.1	4.6	309.2	15.5	324.7
	Dry	147.9	190.1	4.6	342.6	17.1	359.7
2010	Wet	130.3	179.3	4.6	314.2	15.7	329.9
	Median	157.9	202.2	4.6	364.7	18.3	383.0
	Dry	174.8	225.2	4.6	404.6	20.2	424.8
2020	Wet	143.7	201.7	4.6	350.0	17.5	367.5
	Median	175.6	229.0	4.6	409.2	20.5	429.7
	Dry	194.3	254.6	4.6	453.5	22.7	476.2

[a/] Excludes Lone Tree-Deer Valley agricultural demands in Brentwood sub-area.

TABLE 22

PROJECTED DEMAND ON SUPPLY SYSTEM FOR WATER IN TOTAL STUDY AREA a/

Thousands of Acre Feet per Year

Year	Hydrologic Condition	Municipal	Industrial	Agricultural a/	Sub-Total	Losses	Total
1970	Wet	23.2	58.3	6.1	87.6	4.4	92.0
	Median	32.7	66.8	6.1	105.6	5.3	110.9
	Dry	42.8	78.2	6.1	127.1	6.4	133.5
1980	Wet	53.5	101.5	16.6	171.6	8.6	180.2
	Median	69.0	112.4	16.6	198.0	9.9	207.9
	Dry	81.8	125.7	16.6	224.1	11.2	235.3
1990	Wet	98.1	127.8	24.0	249.9	12.5	262.4
	Median	115.9	139.7	24.0	279.6	14.0	293.6
	Dry	128.8	157.0	24.0	309.8	15.5	325.3
2000	Wet	147.9	151.8	23.0	322.7	16.2	338.9
	Median	171.5	171.2	23.0	365.7	18.3	384.0
	Dry	185.9	190.2	23.0	399.1	20.0	419.1
2010	Wet	192.5	179.5	23.0	395.0	19.8	414.8
	Median	220.2	202.4	23.0	445.6	22.3	467.9
	Dry	237.1	225.4	23.0	485.5	24.3	509.8
2020	Wet	236.5	201.9	23.0	461.4	23.1	484.5
	Median	268.4	229.2	23.0	520.5	26.0	546.5
	Dry	287.1	254.8	23.0	564.9	28.3	593.2

a/ Exclusive of agricultural water demands in areas served by East Contra Costa and Byron-Bethany Irrigation Districts and by individual pumping from Delta channels.

Although there are expected to be substantial diversions from offshore in the future under wet and median water supply conditions, the period of availability of high-quality water offshore will extend into the summer months only in very wet years. The capacity of the overland supply system must be sufficient to meet the demands placed upon it during peak periods. Since the District's peak demands occur during the summer months of July, August, and September, it is evident that only in years of "wet" hydrologic conditions in the Central Valley will the potential peak demands on the supply system be alleviated by the availability of high-quality water offshore.

E. PEAK SUPPLY SYSTEM REQUIREMENTS

1. CUSTOMER PEAKING FACTORS

In order to analyze the capabilities of the present Contra Costa Canal, and of possible improvements to the Canal or of additional facilities, to meet the water requirements of the study area, it was necessary to estimate peak flow requirements. In doing this, an analysis was made of the historical peak demands of each of the major customers, based either on data in the District records or on the reports of the individual customers' consulting engineers. Consideration was given to the present availability of customer raw water storage, and whether or not such storage is likely to be provided in the near future. Based on this analysis, factors were adopted for the probable future ratio between peak day demand on the conveyance facility and the average annual daily demand for each municipal customer, the SIC categories of industrial customer, and for agricultural uses. These factors are listed in Table 23.

2. PEAK REQUIREMENTS

To derive peak flows used in analysis of the supply system, the customer peaking factors described above were applied to the projected annual water requirements for each customer by decade, and the results were summarized by section of the present Contra Costa Canal. This procedure is approximate only; in assuming that all

TABLE 23

ANTICIPATED CUSTOMER PEAKING RATIOS[a]

Customer	Peaking Ratio
Municipal:	
Martinez	2.0
Pleasant Hill	2.5
District, Treated Water Division	1.6
Bay Water Service	2.5
Pittsburg	2.5
Antioch	1.6
Oakley	2.5
Industrial	1.2 to 3.8
Agricultural	4.0

---

[a] Defined as ratio between peak day demand and average annual daily demand.

peaks would accumulate on the same day, no credit is taken for possible diversification of demand pattern between the various users and classes of use. However, flow requirements for Canal losses and the effects of operating errors have been ignored. It is assumed that these simplifications are compensating so that the peak flow values derived are comparable to those that will actually be realized in the future if total annual demands develop as projected in this study.

Peak day flow requirements in the Contra Costa Canal estimated according to the foregoing procedure are summarized by decade for each section of the Canal in Table 24. These requirements can be expected to occur in years of median and dry hydrologic conditions in the Central Valley; only in wet years, when high-quality water may be available offshore during the summer months, might the peak demands on the overland supply system be less than those listed in the table.

The peak flows shown in Table 24 are for the present District service area only, and do not include demands in the Byron, Brentwood, and Islands sub-areas. A supply system serving the entire study area would need to have capacity to meet requirements in those sub-areas as well as demands shown in Table 24.

TABLE 24

PEAK DAY CANAL FLOWS - CONTRA COSTA CANAL

Cubic Feet per Second

Canal Section[a]	1970 Peak Day Delivery	1970 Peak Day Flow	1980 Peak Day Delivery	1980 Peak Day Flow	1990 Peak Day Delivery	1990 Peak Day Flow	2000 Peak Day Delivery	2000 Peak Day Flow	2010 Peak Day Delivery	2010 Peak Day Flow	2020 Peak Day Delivery	2020 Peak Day Flow	Present Canal Design Capacity
25[b]	43	43	70	70	93	93	122	122	145	145	163	163	22
10-24	39	82	30	[c]	30	[c]	30	[c]	30	[c]	30	[c]	190-26
9	78	160	120	220	166	289	215	367	253	428	281	474	204
8	3	163	13	233	17	316	22	389	27	455	31	505	225
7	26	189	45	278	66	382	85	474	100	555	110	615	256
6	29	218	37	315	44	426	49	523	55	610	61	676	269
5	0	218	0	315	0	426	0	523	0	610	0	676	291
4	59	277	122	122[d]	163	163[d]	208	208[d]	250	250[d]	287	287[d]	320
3	21	298	27	27[d]	35	35[d]	42	42[d]	51	51[d]	57	57[d]	350
2	0	298	0	0[d]	0	0[d]	0	0[d]	0	0[d]	0	0[d]	328
1	0	298	0	0	0	0	0	0[d]	0	0[d]	0	0[d]	328

[a] See Plate 5.

[b] Martinez Reservoir.

[c] Would become a branch system after construction of Clyde-Martinez pipeline (see text, Section VII-A.2).

[d] Assuming Kellogg Unit or alternate completed (see text, Section VII-A.3).

V. PRESENT SUPPLY SYSTEM

A. BUREAU OF RECLAMATION FACILITIES

1. CANALS

The canals in the Contra Costa Canal system constructed and operated by the United States Bureau of Reclamation are the main Contra Costa Canal and the Clayton and Ygnacio Relift Canals. These features, shown on Plate 5, are the main components of the supply system serving the present District service area.

The Contra Costa Canal is 47.67 miles long over-all. The first 3.95 miles consists of unlined earth section forming the intake channel diverting from Rock Slough, with the balance being concrete lined. As shown on Plate 5, the Canal is divided into 25 separate flow sections, the characteristics of which are summarized in Table 25. The side slopes are at 1½:1 in the lined sections and 3:1 in the earth sections. Bottom slopes in the lined sections range from 0.125 foot per thousand in Section 3, to 0.4 foot per thousand at the terminus. The Canal is equipped with 43 check structures, of which 26 are used for operations, and eight wasteways. Total Canal storage amounts to about 280 acre feet at normal operating level.

The Clayton and Ygnacio Relift Canals are 4.85 and 5.17 miles in length, respectively. The characteristics of these canals are summarized in Table 26. The Clayton Canal draws from the main Contra Costa Canal at mile 28.39 in Section 10, and the Ygnacio Canal takes out of the main Canal at mile 35.27 in Section 12.

2. PUMPING PLANTS

There are four pumping plants at the upstream end of the main Contra Costa Canal, and a plant serving each of the Clayton and Ygnacio relift canals. The characteristics of these pumping plants are listed in Table 27. At each of the plants on the main Contra Costa Canal, space is available for installation of a sixth pump to bring the total pumping capacity up to the full design carrying capacity of the Canal.

TABLE 2[illegible]

CHARACTERISTICS OF CONTRA COSTA CANAL

Section[a]	Location From Mile	 To Mile	Design Capacity, cfs	Bottom Width, ft.	Height of Lining, ft.
1[b]	0.04	2.73	328	24.0	6.5[c]
2[b]	2.73	3.95	328	24.0	6.5[c]
3	3.98	7.04	350	7.0	9.37
4	7.08	11.45	320	7.0	7.81
5	11.45	12.50	291	7.0	7.50
6	12.50	16.49	269	7.0	7.25
7	16.51	20.31	256	7.0	7.10
8	20.31	23.2[illegible]	225	6.0	6.81
9	23.26	26.56	204	6.0	6.17
10	26.56	29.12	190	6.0	5.98
11	29.12	32.34	172	6.0	5.56
12	32.34	35.31	155	6.0	5.24
13	35.31	37.85	140	6.0	4.88
14	37.88	39.44	125	6.0	4.64
15	39.44	40.72	114	6.0	4.36
16	40.72	41.57	102	5.0	4.25
17	[illegible].57	43.37	93	5.0	4.08
18	43.37	43.97	87	5.0	3.96
19	44.08	44.45	67	5.0	3.54
20	44.45	45.08	59	5.0	3.21
21	45.28	46.00	46	5.0	2.87
22	46.23	46.48	37	4.0	2.67
23	46.69	46.88	30	4.0	2.44
24	47.01	47.20	26	4.0	2.29
25	47.55	47.67	22	3.0	3.00

a/ Side slopes are 3:1 in Sections 1 and 2 and 1¼:1 in Sections 3 through 25.

b/ Earth sections.

c/ Design flow depth.

Source: U. S. Bureau of Reclamation data.

TABLE 26

CHARACTERISTICS OF CLAYTON AND YGNACIO RELIFT CANALS

Section	Location From Mile	 To Mile	Type of Lining	Design Capacity, cfs	Bottom Width, ft.	Height of Lining, ft.
Clayton Canal a/						
1	0.28	1.18	Concrete	38	4.00	2.62
2	1.27	2.61	Concrete	36	4.00	2.58
3	2.61	3.42	Concrete	32	4.00	2.42
4	3.42	3.71	Concrete	26	3.00	2.42
5	3.71	4.30	Concrete	21	3.00	2.21
6	4.31	4.54	Concrete	15	3.00	1.75
7	4.55	4.75	Concrete	11	3.00	1.54
8	4.76	4.85	Concrete	11	3.00	3.00
Ygnacio Canal b/						
1	0.01	0.05	Concrete	30	5.00	1.87 c/
2	0.16	1.38	Asphaltic-Concrete	30	2.50	2.58
3	1.38	1.73	Asphaltic-Concrete	26	2.50	2.42
4	1.73	2.71	Asphaltic-Concrete	22	2.50	2.25
5	2.72	3.45	Asphaltic-Concrete	18	2.50	2.00
6	3.45	3.78	Asphaltic-Concrete	14	2.50	1.75
7	3.78	4.38	Asphaltic-Concrete	9	2.50	1.33
8	4.64	4.83	Earth	9	3.00	1.12 c/
9	4.91	5.17	Earth	9	3.00	1.24 c/

a/ Side slopes are 1¼:1 in Sections 1 through 7 and are vertical in Section 8. Begins at Contra Costa Canal Section 10 (Mile 28.39) and ends at Galindo Creek.

b/ Side slopes are 1½:1 in all sections. Begins at Contra Costa Canal Section 12 (Mile 35.27) and ends at Contra Costa Canal Section 13 (Mile 37.66).

c/ Design flow depth.

Source: U. S. Bureau of Reclamation data.

Electric power for pumping is provided by facilities of the Federal Central Valley Project. A power line extends from the Bureau of Reclamation's primary switching yard at Tracy to Contra Costa Canal Pumping Plant Number 3, and from this point power is distributed to the other plants, including the Clayton and Ygnacio Pumping Plants, through a 69 KV system. The United States Naval Reservation at Concord is also served by this system.

3. RESERVOIRS

Reservoir storage on the Contra Costa Canal system is provided in Martinez and Contra Loma Reservoirs. Other raw water storage in the service area is owned by the District or its customers.

Martinez Reservoir is the terminal facility of the Contra Costa Canal, and was included in the original construction program. The reservoir provides about 268 acre feet of storage at maximum water surface elevation 66. The normal operating range of the reservoir is from elevation 45 to 66, with an active storage of 232 acre feet. Under the original concept of the Canal system, Martinez Reservoir was designed to capture terminal flows caused by operating errors. The reservoir is now also being used to meet the peak demands of the customers which are served directly from it.

Contra Loma Reservoir, completed in November 1967, was originally intended as a feature of the proposed Kellogg Unit, and ultimately will have the principal purpose of re-regulating the flows of the proposed Contra Loma Canal. It is located at mile 11.6 on the Contra Costa Canal, and can be filled from the Canal through a 21 cfs capacity pump intake. The outlet works releasing into the Canal have a capacity of 900 cfs. The reservoir has a total capacity of 2,457 acre feet at maximum water surface elevation 211, including 535 acre feet of flood control storage. The operating pool, between elevation 205 and 169, provides 1,671 acre feet of active storage.

TABLE 27

CHARACTERISTICS OF PUMPING PLANTS

Canal	Station Number	Location Mile[a/]	Number of Units	Capacity of Units, cfs	Horse-power	T.D.H., ft.	Type of Unit	Canal Invert Elevation, ft.		
								Upstream	Downstream	Difference
Contra Costa	1	3.97	2 2 1 5	35 70 100 310	125 250 400 1,150	26.5 26.5 28	b/	15.41	-10.33	25.74
Contra Costa	2	4.72	2 2 1 5	35 70 100 310	125 250 400 1,150	25 25 26	b/	38.12	14.53	23 59
Contra Costa	3	5.85	2 2 1 5	35 70 100 310	150 300 500 1,400	33.5 33.5 34.5	b/	69.06	37.12	31.94
Contra Costa	4	7.05	2 2 1 5	33 66 96 294	250 450 800 2,200	50.5 50.5 52.5	b/	116.92	67.69	49.23
Contra Loma	-	11.68	2 1 3	5 11 21	73 140 286	89	c/	150 - 205[e/]	113.05	37 - 92
Clayton	-	28.39	3	13 39	200 600	85	d/	191.38	100.11	91.27
Ygnacio	-	35.27	2	15 30	200 400	89	d/	173.77	91.50	82.27

[a/] Refers to mile on Contra Costa Canal.

[b/] Vertical propeller. All one stage except 96 cfs unit in Pumping Plant No. 4, which is two stage.

[c/] Vertical turbine.

[d/] Horizontal centrifugal.

[e/] Contra Loma Reservoir operating levels.

Source: U. S. Bureau of Reclamation data.

4. LATERALS

The Bureau of Reclamation constructed seven laterals extending service from the Contra Costa Canal to lands devoted to irrigated agriculture, and two laterals for industrial water service. The laterals total some 14.8 miles in length, and consist of asbestos-cement or reinforced concrete pipe of varying diameter. Each lateral contains a number of turnouts providing service to individual customers or groups of customers. The characteristics of the laterals are summarized in Table 28, and their locations are indicated on Plate 5. Although the Bureau constructed the laterals as part of the Contra Costa Canal system, the District is responsible for repayment as well as operation and maintenance.

B. CUSTOMERS' FACILITIES

1. CUSTOMERS' LATERALS

All customers, except for those served from the nine Bureau-owned laterals described above, have their own facilities for taking delivery of water from the Contra Costa Canal. Customers' laterals vary in size from 36 inches to 3/4 inch in diameter, depending on individual needs.

There are 17 privately-owned laterals serving major municipal and industrial customers. These vary in size from 10 to 36 inches in diameter and extend up to two miles from the Canal. Appurtenances at the headworks of the laterals usually include a screening box or trashrack, and booster pumping is not uncommon.

A number of the smaller municipal customers, consisting mainly of golf courses, schools, nurseries, and cemeteries, divert water through small gravity systems or hydropneumatic systems composed of a pump, pressure tank, and pressure pipeline. Laterals range in diameter from 2 to 8 inches. Most customers of this type are located relatively near the Canal.

Agricultural customers' facilities consist for the most part of portable sprinkler irrigation systems, usually supplemented by a small booster pump. The typical system is capable of delivering 240 gpm.

TABLE 28

CHARACTERISTICS OF DISTRIBUTION LATERALS FROM CONTRA COSTA CANAL

			Design Flow (cfs)		Inside Pipe Diam. (inches)			
a/ Lateral	Primary Use	Length (feet)	First Sec.	Last Sec.	First Sec.	Last Sec.	Total No. of Turn-outs	No. of Turn-outs in Service
5.3	c/	5,607	5.1	2.0	21	15	6	5
6.2b/	c/	7,920 1,425	7.9	2.0 2.1	21	12 12	11 4	11 4
7.1b/	c/	13,451 1,889	9.0	2.0 3.6	27	12 12	16 2	15 2
7.3	c/	11,022	10.4	2.3	27	12	15	13
9.1	c/	8,445	12.2	4.3	21	15	8	8
14.0	d/	8,285	4.5	4.5	15	15	2	1
25.6	d/	9,116	19.0	11.2	27	24	2	2
36.6	c/	6,495	6.8	3.6	24	15	10	7
Y-2.6	c/	4,791	4.6	2.0	21	12	8	6

a/ Number refers to Canal mile post as measured from beginning of Contra Costa Canal, except for Lateral Y-2.6 which extends from the Ygnacio Relift Canal 2.6 miles downstream from the Ygnacio Pumping Plant.

b/ This lateral bifurcates into two pipelines.

c/ Irrigation.

d/ Industrial.

Customers in the Groups and Associations category take water from the Canal through 47 separate systems, with the membership in each Group largely dictating the size of the diversion lateral. Memberships vary from 3 to 460 persons, and diversion laterals vary in diameter from 2 to 12 inches. Hydropneumatic systems are usually employed.

Individuals diverting directly from the Canal for domestic irrigation generally take water through small hydropneumatic systems having pipe sizes running from 3/4 to 2 inches in diameter. Individuals of this type are known as "Flat Raters." Property belonging to these individuals is in almost all cases located adjacent to the Canal.

2. RAW WATER STORAGE

The main raw water storage in the study area, aside from the Bureau's Martinez and Contra Loma Reservoirs, is provided by the City of Antioch, and by the District's Treated Water Division at Mallard Reservoir. These facilities are shown on Plate 5. Some industries have small amounts of raw water storage.

The City of Antioch reservoir has a total capacity of 735 acre feet at full water surface elevation 163, and is used by the City primarily to store water produced from the San Joaquin River. An intake from the Contra Costa Canal is located at mile 10.5 A 200 horsepower pumping unit at the intake can deliver up to 14.5 mgd either into the reservoir or directly to the City's water treatment plant. As part of a water system modernization program now being undertaken by the City, a new intake is under construction at Canal mile 10.8. This intake will include a pumping station having an initial capacity of 25 mgd, with provision for future expansion to 40 mgd.

Mallard Reservoir has a capacity of 2,980 acre feet at full water surface elevation 33. The reservoir was originally designed so that this capacity could be approximately doubled by increasing the height of the embankments 10 feet. Further increase in capacity could be achieved by excavating from within the existing reservoir area. Water from the Contra Costa Canal is delivered to Mallard Reservoir by gravity through a 30-inch turnout located at mile 26.3. The reservoir is also used to store water produced from Mallard Slough.

The District's Treated Water Division also has 12.3 acre feet of storage located at the Ygnacio Treatment Plant, Canal mile 37.7. Other raw water storage in the District's service area totals about 130 acre feet, most of which belongs to one industrial customer.

3. OFFSHORE SUPPLY SYSTEMS

The City of Antioch and the District's Treated Water Division divert a portion of their raw water supplies from the Sacramento-San Joaquin Delta when it is available in suitable quality. The locations of their offshore supply systems are shown on Plate 5.

The City of Antioch diverts its offshore supplies through a 400 horsepower pumping unit and an 18-inch diameter pipeline 16,500 feet in length leading to the City's raw water reservoir. The system is capable of producing from 6.0 to 6.5 mgd. The TWD system consists of a pumping station at Mallard Slough having a total installed capacity of 750 horsepower in three units, and a 33-inch diameter pipeline leading to Mallard Reservoir. This pipeline consists of 24,000 feet of reinforced concrete pipe, and 15,500 feet of mortar-lined welded steel pipe.

In addition to the municipal systems described above, several of the major water-using industries in the District whose plants are situated on the waterfront develop some of their high-quality raw water needs from offshore. During extended periods of availability, these plants may produce virtually all of their needs from the offshore supply. A number of plants use large quantities of offshore water for cooling purposes, but the chloride ion content of the supply is not of importance in these cases because the cooling systems are constructed of materials able to withstand high concentrations of chlorides. Some industries also use the offshore supply for washdown, waste dilution and fire protection. Chloride levels are of little importance for these uses.

VI. SUPPLY SYSTEM DEFICIENCIES

A. SERVICE PROBLEMS

1. WATER QUALITY

The present Contra Costa Canal system, a Federally owned facility, is not able to provide water supplies having mineral quality at all times suitable to the purposes for which the water is used. Usually there are two periods during the year when the quality of water available at Rock Slough falls below acceptable levels for municipal and industrial uses. The first of these occurs in the winter, when runoff in the San Joaquin River flushes drainage water accumulated from the previous irrigation season into the Delta channels. Historically, the chloride ion content of Rock Slough water pumped into the Contra Costa Canal system has exceeded 100 ppm for an average of about 80 days during the winter season. The second period of poor quality water occurs during the summer months, when the low inflow in the Sacramento and San Joaquin Rivers to the Delta permits saline water from San Francisco Bay to intrude into the Delta channels.

The upper limits of chloride ion concentration and total dissolved solids content recommended by the United States Public Health Service for municipal water supplies are 250 ppm and 500 ppm, respectively. However, the Contra Costa County Water District would prefer to deliver water containing not more than 100 ppm chlorides as a reasonable upper limit, in order to protect industrial customers from substantial economic penalties caused by the use of high-chloride process water, and to prevent detriments to domestic consumers due to hard water. The historic availability of water in the Contra Costa Canal, expressed as a function of chloride ion concentration, is shown on Plate 10. As can be seen from this Plate, water containing 100 ppm or less chlorides has been available at Rock Slough only 65 per cent of the time. Furthermore, several instances have occurred in the past when the chloride ion concentration has risen even above the Public Health Service recommended limit of 250 ppm. Chlorides at Rock Slough exceeded this value for 23 days in 1961 and 28 days in 1959, when the maximum historical value of 374 ppm was experienced. Situations such as this are likely to occur with increasing frequency in the future during periods of low runoff in the Central Valley, as Federal and State export projects divert more and more water away from the Delta, and particularly after the Peripheral Canal is in full operation. Increasing irrigation development in the San Joaquin Valley will also aggravate these quality problems.

Contract I 75r-3401 between the District and the Bureau of Reclamation for delivery of water through the Contra Costa Canal does not provide quality objectives or guarantees, except that the District is not required to accept and pay for any water having a chloride ion concentration in excess of 250 ppm. When this contract was written it was contemplated that most of the Canal water would be used for agricultural purposes, which could tolerate reasonable shortages and poorer quality water. However, due to the radically different pattern of development in the District from that anticipated in the 1930's, the provision of Contract I 75r-3401 regarding water quality is of little or no value, since it does not recognize the need for a municipal water supply agency to make water of suitable quality available to its customers 100 per cent of the time.

At present, the only measurements of the quality of Canal water made on a daily basis are tests for temperature, chlorides, and total dissolved solids on samples taken at Pumping Plant No. 1. Complete chemical analysis of Canal water is made only on a monthly basis. No bacteriological analyses are made at all. For proper control, chemical and perhaps bacteriological analyses should be made on samples taken frequently at the intake to the Canal, at Contra Loma and Martinez Reservoirs, and possibly at a point in the Canal about mid-way along its length. The results of these tests should be made available to all of the District's customers who desire them. The precise extent of a desirable water quality testing program should be the subject of a detailed study.

2. CAPACITY OF FACILITIES

When the Contra Costa Canal was originally designed, the selected design capacity for each of the various reaches was predicated on large agricultural requirements, which at that time were projected to be the principal demands on the facility. However, these agricultural needs have failed to materialize. Instead, most of the supplies are delivered to a relatively small number of large industrial and municipal customers having turnouts at widely spaced intervals. Consequently, the Canal is not operating as originally planned, with some sections being required to deliver substantially more water than designed for, and others delivering no water at all. This is indicated on Plate 5 and in Table 24, which also clearly shows that this situation is expected to become more pronounced in the future. It is anticipated that in year 2020, most of the Canal deliveries will be made out of Martinez Reservoir and from Sections 9, 7 and 4. Little or no water will be delivered from the other sections.

A comparison of the anticipated peak day flows for the Canal sections with the present design capacity of the various sections is shown in Table 24 and on Plate 11. It can be seen that, without improvements, the design capacities of Sections 3 and 4 would probably be exceeded by 1973, with those of Sections 5 through 9 being exceeded in 1975 and after. Also shown on Plate 11 are the present installed capacities of the main pumping plants as listed in Table 27. Peak flow requirements in Sections 3 and 4 would exceed these capacities as early as 1971, without installation of new units.

A critical situation exists at the terminal reaches of the Contra Costa Canal, where the design capacity of the Canal is reduced from 59 cfs to 22 cfs. This capacity falls far short of that needed to meet the present peak demands in the Martinez sub-area, although some reduction in required peak delivery rates in these reaches is being achieved by drawing on storage in Martinez Reservoir. Some increase in the carrying capacity of this portion of the Canal was achieved in August, 1966, when temporary "sideboarding" was constructed by the Bureau of Reclamation from Sta. 2435+00 to Sta. 2487+00. This sideboarding consists of sacks containing soil-cement mix, stacked on top of each other to a height of about one foot above the top of the existing lining. The sideboarding was expected to have increased the carrying capacity of this reach of the Canal to about 37 cfs; however, a 10-day conveyance test conducted by the Bureau indicated that, even under ideal operating conditions, an average flow of only 27.4 cfs could be obtained in the reach after sideboarding. This is less than the estimated average demand at Martinez Reservoir occurring in the peak month in 1970. Thus the delivery capacity into Martinez Reservoir must be further augmented by 1970 in order to avoid restrictions on service.

3. OPERATING CONTROL

The Contra Costa Canal system is now being operated following a procedure which may be called the "pool balance" method. A desirable water level is established for each of the 25 sections of the Canal, with the increase or decrease in Canal storage being known for each increment of departure of the actual water level from the desirable level. Readings of the water level in each of the 25 pools are usually made four times each day by Bureau of Reclamation operating personnel, and the total change in system storage for the day is calculated. Also, the Bureau is informed of anticipated demands for the ensuing 24-hour period by the District, based on water orders received from its customers. A pumping schedule is then set for the 24-hour period, which is calculated to meet the anticipated demands and to return the Canal storage to its desirable level.

There are a number of problems which prevent the "pool balance" method from providing efficient operation of the Canal. Although the range in capacity of the units available at the four main plants provides some flexibility in meeting the 24-hour pumping schedules, it is usually necessary to pump for short periods of time at rates well above the average 24-hour schedule in order to approximate the desired total amount of flow as closely as possible. This procedure creates flow surges in the system which complicate the problem of accurately determining pool storage.

Customer demands are based on water orders which are placed by municipal and industrial customers on a two-week basis. These orders represent the customers' estimates of their probable average flow requirements for the period. The requirement for a two-week advance order was imposed by a District regulation which became effective January 1, 1967. Prior to that time there was no consistent method of estimating customers' water needs in advance. The new regulation requires each customer to estimate his average daily rate of delivery over the order period, and also requires the customers to notify the District at least 24 hours in advance of changes in their orders.

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Although the water ordering system has improved operations since it was instituted, the procedure still gives only a poor prediction of the actual daily demands on the Canal. As an illustration of this, deliveries to one of the District's major industrial customers for the month of August, 1967 are shown on Plate 12, which also shows that customer's water orders for the month.

Another significant operating problem is created by the fact that many of the District's major customers have come to regard the Contra Costa Canal as a large reservoir rather than as a supply conduit of limited capacity, and have been taking their deliveries at widely fluctuating rates of flow. For example, one major municipal customer, which has no raw water storage of its own, operates its treatment plant on an eight-hour shift basis with the plant being shut down 16 hours a day. The result is that when that customer is taking water from the Canal, its average demand rate is three times higher than would be the case if the deliveries were uniform over a 24-hour period. This type of peaking operation robs the Canal of capacity which could be used to meet larger total District needs assuming these needs were all leveled to the extent reasonably possible.

The result of these conditions is that the ability to meet customer demands now depends to a great extent on the ability to use a portion of the Canal to store water which can be drawn down during peak demand periods and refilled during off-peak periods. This in turn reduces the capacity of the Canal to transport flows along its length. As the total demands within the District increase in the future, more and more of the Canal capacity will be required to transport flows, and less and less will be available for storage to meet fluctuations in demand. As this occurs, the effect of the operating problems described above will be intensified unless corrective measures are taken.

4. SYSTEM RELIABILITY

At the present time, all water delivered through the Contra Costa Canal system must pass through a series of four pumping plants, as described in Section V-A.2. These pumping plants are subject to mechanical failure or electrical power outage, which could affect one or all of the pumping units.

Historically, unscheduled power outages have been an infrequent occurrence. Only three outages have been recorded, the longest occurring on September 23, 1964, and lasting about 6½ hours. This outage was caused by an accident in which a truck collided with one of the poles in the transmission line between the Tracy switchyard and Pumping Plant Number 3. It can be anticipated that this type of accident will occur more frequently in the future as the eastern portions of the study area become more urbanized.

Although there have never been any interruptions in service due to mechanical failure of a pumping unit, the likelihood of such a failure is constantly increasing as the capacity of the pumping plants is approached.

Another possible cause for interruption of service is a failure of the Contra Costa Canal itself. Two such failures have occurred in the past, in 1952 and 1955. The 1952 break was due to a landslide in Section 12 near Galindo Creek, causing a three-day service interruption. The 1955 failure occurred in Section 20 and was also caused by landslides. In both cases, service was restored by installing large diameter corrugated metal pipe in the breaks.

At the present time the only emergency storage available to the Canal system is the 1,671 acre feet of active storage in Contra Loma Reservoir, which can provide about three days' peak supply at the year 1970 demand level. This facility is capable of gravity service downstream from its connection with the Contra Costa Canal at the head of Section 5, and can back feed in Section 4 as far as Pumping Plant Number 4 if withdrawals in this Section are not too great. However, with present pumping equipment, it would take about 40 days to refill the reservoir once emptied. Canal customers in Section 3 have no emergency protection whatsoever, except for the water contained in this section at the time of service interruption.

Some additional protection is available to the City of Martinez and the industries drawing from the 268 acre foot Martinez Reservoir, but Bureau of Reclamation criteria limiting the rate of drawdown in this reservoir are such that it can provide only about six hours' supply on the peak day at the 1970 demand level.

In contrast to this situation, the East Bay Municipal Utility District now has some 157,000 acre feet of terminal raw water storage capable of providing gravity service to all parts of the District, and has plans to add about 97,000 acre feet more. The storage reservoirs of the San Francisco Water Department in the Bay Area contain almost 240,000 acre feet of water which is available for emergency gravity supply.

B. OTHER PROBLEMS

1. CANAL SAFETY

Canal safety has been a persistent problem ever since the Contra Costa Canal first went into operation in 1940. Since that time, 41 persons have lost their life by drowning in the Canal.

In the early 1950's drownings increased in frequency of occurrence, and in July 1954 the District embarked on a program of surveillance and public education designed to lower the drowning rate. A Canal patrol of deputy sheriffs was formed, and a comprehensive program involving dissemination of literature aimed at awakening and maintaining public awareness was undertaken.

As a result of this program, the rate of drowning in proportion to the total population within the District has been substantially reduced over-all and within every age group. However, the group least affected has been very young children, especially those of pre-school age. Of the 15 drownings occurring since the District's safety program was initiated, 10 were children under nine years of age, and of these, six were pre-school aged children.

An important factor affecting safety is the fact that the Contra Costa Canal was not fenced when it was constructed, and that fences have been added subsequently only in localized areas. Even these fences are now inadequate in preventing access to the Canal, especially by children. The primary reason for this is that the fences are not maintained by filling holes which develop beneath them, through which children can enter the right-of-way. Also, cross-fencing the Canal is not complete, so that in many areas children can simply walk around the end of the right-of-way fence.

The United States Bureau of Reclamation, which constructed the Canal to serve an agricultural area, has taken the position that it is not responsible for fencing since the Canal preceded urban development. The District has also disclaimed responsiblity on the grounds that it is neither the owner of the Canal nor responsible for operation and maintenance. It is apparent, however, that complete and adequate fencing of all open waterways is the only means by which continued loss of the lives of small children by drowning in the Canal can be effectively reduced.

Safety devices are provided at many points in the Canal in the Diablo Valley area, particularly at siphons. These devices include ladders, grates, and floating life lines. However, 18 siphons on the main Canal, primarily upstream of Clyde, do not have grates, and 10 do not have floating lifelines. In addition, there is a need for more escape ladders by which persons can get themselves out of the Canal should they fall in.

2. MAINTENANCE DEFICIENCIES

The present maintenance procedures being followed for the Contra Costa Canal are deficient in some respects compared with standards desirable for a municipal supply system. Treatment of the Canal surface and right-of-way for weed control should be carried out frequently enough that weeds cannot develop to an unsightly stage. The esthetic appearance of the Canal would be greatly improved by landscaping at frequently-used public road crossings.

Adequate surface maintenance is difficult under present conditions because only about 5% of the total Canal, from mile 4 to mile 7, has an access road on both sides. Maintenance would also be enhanced if operating personnel could remotely control gates along the access roads from their automobiles, instead of having to leave the cars and open the gates by hand as at present.

Positive measures should be undertaken to guard against the accidental introduction into the Canal of toxic materials, particularly at road crossings. One such incident occurred in 1965 when a truck loaded with bulk fertilizer fell into the Canal while the driver was opening a gate. The Canal could be provided with a reinforced concrete cover sufficiently far upstream and downstream from road crossing to ensure that a highway accident will not result in pollution of the District's water supply.

Bridges crossing the canals in the Contra Costa Canal system are in various ownership, including the Bureau of Reclamation, the State of California, Contra Costa County, and cities and private individuals. Some of the wooden bridges in private ownership are not being properly maintained. Measures should be taken to ensure that all bridges crossing the Canal are adequately maintained.

3. METERING INADEQUACIES

a. Major Customers. As was stated in Section II-A.2, about 91% of the District's total water sales are made to only 15 major customers. Thus, the manner in which sales to these customers are measured, and the accuracy of measurement, are of prime importance to the District.

The 15 major customers at present take their water supplies from the Contra Costa Canal through a total of 20 different turnouts. The location, size, and ownership of each of these turnouts is indicated in Table 29. Also shown in Table 29 is the location of the meter for each turnout, and the meter ownership, maintenance schedule, type of meter output, and identification of the party responsible for reading each meter.

A number of the 20 major meter installations are owned by the customers and located in the customers' plants. This situation is satisfactory as long as the District has free access to each meter, and can ensure the accuracy of the readings. At the present time, however, in more than half the installations, the District relies on its customers to read the meters and to maintain them in good operating condition. As a matter of good business practice, the District should be the party responsible for all meter reading and maintenance. The Directors have recognized this and adopted a regulation on January 1, 1966, which provides that all service connections for municipal or industrial purposes installed after that date shall be equipped with a meter owned, operated, and maintained by the District. The principles of this regulation should be made to apply also to all of the 20 meter installations listed in Table 29, at least with regard to the operation and maintenance of those installations. As the meters now owned by customers wear out, they should be replaced by District-owned meters located at the head of the laterals.

Meters maintained by the District are dismantled and thoroughly cleaned, inspected, and repaired if necessary on an annual schedule. Accuracy of these meters is maintained by a semi-annual calibration and a weekly manometer check performed at the time the meter is read. This schedule of maintenance should be rigorously extended to all of the 20 major meter installations.

The type of meter output varies among the major installations, including circular charts, strip charts, and totalizers. The output is generally satisfactory for the present method of operation of the Contra Costa Canal system and for the type of rate structure which the District now has. However, as will be discussed in Section VII-A.7, the capabilities of the metering equipment in improving the operation of the Contra Costa Canal system need to be more fully exploited.

b. Other Customers. The District's smaller municipal and industrial customers and the groups and associations drawing from the Contra Costa Canal for domestic irrigation supplies are mainly metered, whereas flat rate sales to individuals for domestic irrigation and to agricultural users are estimated on the basis of area served. These procedures satisfactorily account for the relatively small amount of water involved.

TABLE 29

CHARACTERISTICS OF METERING SYSTEM
CONTRA COSTA CANAL

Turnout No.	Customer	Type[a/] of Use	Turnout Location (Station)	Lateral Ownership	Size of Pipeline (inches)	Meter[a/] Location	Meter Ownership	Meter Maintenance Schedule	Type of[a/] Recorder	Reading Interval	Meter Read By
1	TWD - Chenery	M	1383+40	TWD	24	HL	CCCWD	Annual	CC	Weekly	CCCWD
2	TWD - Ygnacio	M	1985+50	TWD	24	HL	TWD	Biannual	CC	Daily	TWD
3	Martinez	M	Martinez Reservoir	Customer	30	HL	CCCWD	Annual	CC	Weekly	CCCWD
4	Pittsburg	M	903+50	Customer	30	HL	Customer	Unknown	CC	Daily	Customer
5	Antioch	M	555+40	Customer	24	HL	Customer	Unknown	SC	Monthly	CCCWD
6	Oakley County Water Dist.	M	210+50	Customer	24	P	Customer	Unknown	CC	Daily	Customer
7	Pleasant Hill	M	2192+10	Customer	14	P	Customer	Unknown	CC	Weekly	Customer
8	Bay Water Company No. 1	M	1079+00	Customer	12	P	Customer	Unknown	T	Monthly	Customer
9	Bay Water Company No. 2	M	1019+40	Customer	10	P	Customer	Unknown	T	Monthly	Customer
10	Phillips Petroleum	I	1351+23	Customer	30	HL	CCCWD	Annual	CC	Weekly	CCCWD
11	Phillips Petroleum	I	Lateral Sta. 91+78	CCCWD Lat. 25.6	18	LT	Customer	Unknown	T	Monthly	CCCWD
12	U. S. Steel	I	798+60	Customer	24	HL	CCCWD	Annual	CC	Weekly	CCCWD
13	U. S. Steel	I	798+60	Customer	18	HL	CCCWD	Annual	CC	Weekly	CCCWD
14	U. S. Steel - Pipe Mill	I	739+30	Customer	12	P	Customer	Unknown	CC	Daily	Customer
15	Fibreboard	I	421+55	Customer	30	P	Customer	Unknown	CC	Daily	Customer
(16	Fibreboard	I	486+00	Customer[b/]	36	P	Customer	Unknown	CC	Daily	Customer
(16	Crown Zellerbach	I	486+00	Customer[b/]	36	P	Customer	Unknown	T	Daily	Customer
17	Shell Oil	I	Martinez Reservoir	Customer	20	HL	CCCWD	Annual	CC	Weekly	CCCWD
18	Dow Chemical	I	739+30	CCCWD Lat. 14.0	15	HL	CCCWD	Annual	CC	Weekly	CCCWD
19	Monsanto Chemical	I	Lateral Sta. 81+80	CCCWD Lat. 25.6	14	LT	Customer	Unknown	T	Monthly	CCCWD
20	Shell Chemical	I	1035+30	Customer	10	P	Customer	Unknown	T	Monthly	Customer

a/ Key:

M = Municipal	LT = Lateral Turnout
I = Industrial	CC = Circular Chart
HL = Head of Lateral	SC = Strip Chart
P = In Plant	T = Totalizer

b/ Fibreboard and Crown Zellerbach jointly own this lateral.

Source: Contra Costa County Water District data.

4. DRAINAGE INLETS

At the present time, there are some 340 open drains which discharge surface drainage waters directly into the Contra Costa Canal system. This situation creates a severe health hazard due to the possibility of toxic materials, such as insecticides and herbicides, being flushed into the Canal. Also, the large inflows of storm drainage after a heavy rainfall make proper operation and maintenance of the Canal difficult. These drains should all be removed and replaced with culverts or overchutes, so that no water can enter the Canal except that which is known to be suitable for municipal and industrial purposes.

VII. PROPOSED IMPROVEMENT PROGRAM

A. NEAR TERM IMPROVEMENTS (TO 1980)

1. CLYDE-MARTINEZ PIPELINE

As was shown in Section VI-A.2, it will be necessary to augment the input capacity to Martinez Reservoir by 1970. The United States Bureau of Reclamation, as well as the District, is aware of this need, and both have prepared study reports on the problem, references 9 and 10. The Bureau of Reclamation, in reference 10, recommends that a pipeline having a capacity of 75 cfs be constructed between the Contra Costa Canal at Clyde and the Martinez Reservoir by 1970.

As can be seen from an inspection of Plate 5, there are now only two customers drawing significantly large quantities of water from that portion of the Contra Costa Canal looping around Diablo Valley between Clyde and the Martinez Reservoir. These are the City of Pleasant Hill and the Ygnacio Treatment Plant of the District's Treated Water Division. The management of TWD has indicated that the Ygnacio Plant will be dismantled in the near future. It is thus evident that there is no need for a large-capacity facility in this area except to deliver supplies directly into Martinez Reservoir. The most economical means of providing this delivery capacity would be through as short a pipeline as possible joining Martinez Reservoir to the Contra Costa Canal at Clyde.

As will be discussed subsequently, it is proposed that the City of Pleasant Hill and the minor demands on the west side of Diablo Valley be served by a pumping plant and pipeline drawing from Martinez Reservoir. These demands would be a load on the Clyde-Martinez pipeline, as would the demands of the City of Martinez and industries drawing from Martinez Reservoir. Another demand on that pipeline would be service to the City of Benicia, in Solano County. Benicia has purchased small amounts of water from the District, transmitted through a 10-inch diameter pipeline carried on the Benicia-Martinez Bridge. The capacity of this pipeline under present conditions is about 3 cfs.

The anticipated peak day demands which would be placed on a pipeline from Clyde to Martinez Reservoir are shown in Table 30. These demands were determined as described in Section IV-E.2, and were derived from Table 24. The potential peak demand of 3 cfs for the City of Benicia is not listed in Table 30 since it is probable that this area will have a supplemental source of supply in the future and the City will then need its connection to the District only for emergency service.

For purposes of selecting the desirable size of the Clyde-Martinez pipeline, the capability of Martinez Reservoir in meeting part of the peak load is taken into account as shown in Table 30. As demands on the pipeline approach its design capacity in the future, Martinez Reservoir should be operated partly as a peaking facility. During the early years after installation of the pipeline, this type of operation would not be required. With a rate of drawdown not exceeding two feet per day, the limit allowable under current Bureau operating criteria, a flow rate of 14 cfs could be released from storage in the reservoir when the water surface is at the maximum elevation 66 feet. With the water surface at normal operating elevation 57, the maximum permissible discharge rate would be 11 cfs. This latter value has been adopted for study purposes.

The proposed route of the Clyde-Martinez pipeline is shown on Plate 13. The total length of the pipeline would be approximately 25,300 feet. With the minimum available head between normal water surface elevation 107 in the Canal at Clyde and maximum water surface elevation 66 in Martinez Reservoir, the peak day demand on the pipeline shown in Table 30 for year 2020 could be provided by gravity through a 72-inch diameter pipe. However, the most economical means of providing the necessary capacity would be to construct a 60-inch diameter pipeline initially, and then to install a booster pumping plant about half way along the line when increased capacity is required in the future. The booster plant would probably not be needed until about year 2000. However, as stated in Section III-B.5, there is a possibility that the effluent from the Central Contra Costa Sanitary District's treatment plant, located in this area, could be used to meet a part of the industrial water requirements now served from Martinez Reservoir. If this re-use of reclaimed waste water could be initiated before the need for the booster plant develops, the installation of the plant might be deferred for a number of years and perhaps indefinitely.

TABLE 30

PEAK DAY DEMANDS ON CLYDE-MARTINEZ PIPELINE

Cubic Feet per Second

	1980	1990	2000	2010	2020
Martinez Reservoir					
Municipal Demand	20	35	56	71	82
Industrial Demand	50	58	66	74	81
West Side Loop					
Municipal Demand	5	5	5	5	5
Public Area Irrigation	6	6	6	6	6
Total Demands	81	104	133	156	174
Less: Effect of Drawdown in Martinez Reservoir	11	11	11	11	11
Demand on Pipeline	70	93	122	145	163

The Treated Water Division of the District is now in the process of increasing the diversion capability from Contra Costa Canal to Mallard Reservoir to 116 cfs. A 48-inch diameter pipeline has already been constructed from the Bollman Treatment Plant, now under construction on the south side of the reservoir, to a point near the northeast corner. The increased delivery capacity could most economically be provided from this point back to the Canal by combining with the proposed Clyde-Martinez pipeline. Thus, as shown on Plate 13, the new pipeline should be 81 inches in diameter from the Contra Costa Canal takeout to the intersection with TWD's 48-inch line, and 60 inches in diameter from that point on to Martinez Reservoir, with provision made for future installation of a pumping plant on the east bank of Walnut Creek. At the design stage, careful consideration should be given to the type of transition structure to be provided between the Contra Costa Canal and the Clyde-Martinez pipeline. Consideration should also be given to the possibility of increasing the available head on the line through use of an altitude control valve at the Martinez Reservoir terminus.

2. DIABLO VALLEY LOOP

a. Water Requirements. Estimates of future requirements for raw water service from the Contra Costa Canal system in the reaches between Clyde and the Martinez Reservoir were based on a report prepared by the District, reference 11. Categories of water use in this area include municipal, agricultural, industrial, public area irrigation, and domestic irrigation. The estimated annual water demands in Diablo Valley developed in reference 11 are summarized in Table 31: these values are compatible with the anticipated total water demands in the study area described in Section IV of this report.

In order to estimate the needed size of improvement works, annual design demands were converted to peak flow rates in cubic feet per second. In doing this, consideration was given to the possibilities of scheduling certain of the deliveries for off-peak hours, and to the generally agricultural nature of many of the uses which would permit some restrictions in service during critical periods.

TABLE 31

PROJECTED DEMAND ON DIABLO VALLEY LOOP

Contra Costa Canal Section	Design Water Requirement,[a] acre feet per year
10	257
Clayton Relift	966
11	1,031
12	650
Ygnacio Relift	2,063
13	594
14	122
15	784
16	47
17	1,591
18	60
19	157
20	55
21	120
22	27
23	53
24	40
25	10

[a] From Contra Costa County Water District data, reference 11.

b. Alternatives Studied. Two possible alternatives were studied for future service to the area and disposition of the present Contra Costa Canal in the reaches between Clyde and the Martinez Reservoir. One possibility would be to maintain the existing Canal in service with complete fencing to provide adequate safety, and the other would be to replace the Canal with a pipeline system. A comparison of the costs of these alternatives, including the present worth values of future operating and maintenance costs, showed that the most economical solution would be to replace the Canal with a pipeline system. The significant consideration in this comparison was the operation and maintenance costs; although the pipeline alternative would require a greater capital expenditure initially, the savings in operation and maintenance costs would more than offset this.

c. East Side Improvements. The recommended plan for future raw water service in Diablo Valley is shown on Plate 14. Along the east side of the Valley, the existing Contra Costa Canal would be maintained in its present condition within the boundaries of the United States Naval Reservation, since safety is not a problem in this area. Downstream from the Reservation, the Canal would be filled in and and the right-of-way would be available for improvement as a green belt for public use. Raw water service would be provided through a system of pipelines laid in the filled Canal.

Between the Navy base and Galindo Creek, flow would be by gravity through a 42-inch diameter pipeline, with an overflow and wasteway into Galindo Creek. A new pumping plant would lift the water from this point through a 30-inch diameter pressure pipeline into a small storage reservoir near the existing Ygnacio Pumping Plant. This reservoir would maintain service pressure during periods of peak demand, and could also provide a recreational opportunity. From this reservoir, termed Ygnacio Reservoir, service would be provided along the present Canal alignment through a 12-inch pipeline terminating at Walnut Creek, and along the alignment of the Ygnacio Relift Canal through a pipeline ending at Pine Creek. The latter would consist of 24-inch and 12-inch diameter pipe, as shown on Plate 14. The portion of the Ygnacio Canal beyond Pine Creek would be abandoned.

The Clayton Relift Canal would be maintained in its present condition within the boundaries of the Navy property as far as the Mount Diablo Creek siphon. From that point onwards to Galindo Creek, the Canal would be replaced by a 6-inch diameter pipeline providing gravity flow.

The existing Clayton and Ygnacio Pumping Plants would be dismantled under this recommeded plan of improvement. A new 45 horsepower pumping unit would be installed at the Clayton plant, properly sized to provide the required service.

d. West Side Improvements. Requirements on the west side of the Diablo Valley would be met by pumping from Martinez Reservoir. A new pumping plant, located below the Reservoir, would contain three 150-horsepower pump units, one of which would be held on standby. Water would be pumped into a 1 million gallon storage tank on Shell Hill, from which point service would be provided along the existing Canal alignment through a pipeline terminating at Walnut Creek. This pipeline would be 24 inches in diameter as far as the Pleasant Hill turnout, and would vary from 16 inches to 10 inches from that point on to Walnut Creek, as shown on Plate 14. As on the east side, the existing Canal would be filled in and the right-of-way made available for a green belt for public use.

3. CANAL ENLARGEMENT

a. Sections 5-9. As was stated in Section VI-A.2 of this Report and shown on Plate 11, it is anticipated that without improvements, water delivery requirements would exceed the design carrying capacity of the reach of the Contra Costa Canal from Section 5 through Section 9 by about 1975. Three alternative methods of augmenting the delivery capacity of these sections were studied:

(1) Enlarge the existing Canal flow section by extending the sides at a 1½;1 slope until the full flow depth is increased by four feet. Modify Canal structures as necessary to realize the full increased carrying capacity of the enlarged section.

(2) Maintain the existing Canal as it is at present, and construct a parallel pipeline in the Canal right-of-way to carry future requirements. The parallel pipeline would be constructed in two stages.

(3) Replace the Canal by constructing a pipeline in the Canal right-of-way having sufficient capacity to meet demands through about year 2000. Immediately after this pipeline is in service, fill existing Canal. Subsequently, construct a second-stage pipeline in the filled section to meet demands beyond year 2000.

Each of these alternatives was studied considering requirements with and without provision of a 12,000 acre foot reservoir above the Canal at the end of Section 8. This reservoir, termed the Nichols reservoir, could provide peaking ability which would have the effect of deferring the need for augmentation of facilities upstream therefrom, and could also provide some emergency storage protection for customers downstream from it. Also, the pipeline alternates were studied considering both gravity flow conditions and the use of booster pumps.

Of these alternatives, that of enlarging the Canal section was found to be by far the most economical. It was also found that the Nichols reservoir would not permit enough deferral of construction costs in the Canal enlargement to justify its estimated $7 million cost for that purpose alone. The reservoir would provide emergency storage only against the occurrence of Canal failure downstream from Contra Loma Reservoir, and would provide protection only to customers that already have a degree of emergency storage available to them. It was thus concluded that construction of Nichols reservoir is not warranted for near-term purposes, although a smaller reservoir at the site may be desirable in the future for emergency storage.

A general cross-section indicating the enlargement recommended for the Contra Costa Canal in Sections 5 through 9 is shown on Plate 15. A four-foot increase in flow depth was found to be generally necessary to provide the required increase in carrying capacity. Further studies at the pre-construction design level may indicate that an increase of less than four feet may be appropriate in some areas.

In the fill sections of the existing Canal, the top of the roadway embankment is generally not less than 2½ feet above the top of the Canal lining. In cut sections this distance is greater, averaging in excess of five feet. Thus, after enlargement, the flow section would mostly be either in natural ground or in embankment constructed as part of the original Canal. The passage of time since its construction should have brought this embankment to a relatively well-consolidated state. However, further studies at the pre-construction design level may indicate that some portions of the embankment may require additional consolidation.

Discussions with several local contractors indicated that the most feasible procedure for construction of the enlargement would probably be through creation of a 16-foot access roadway continuously on both sides of the Canal at a height of from seven to eight feet above the existing lining, as shown on Plate 15. These roads would provide for maximum ease of access of men and equipment during construction, and would also permit improved surface maintenance of the Canal right-of-way after enlargement. After completion of the roads, grading equipment could readily trim the Canal slopes to the desired configuration. A shotcrete lining, reinforced with with wire mesh, would then be applied in the enlarged flow section from a rig riding on the bench at the top of the existing lining. Construction in this manner would eliminate the need for specialized equipment and would minimize cost. Toe drains would be provided where necessary to ensure stability of the enlarged Canal embankments. New fencing would also be provided, as is discussed in Section VII-A.5.

The increased Canal flow section, enlarged in this manner, would permit continued service through the Canal from Contra Loma Reservoir to Clyde until about 1992. At that time, increased capacity would have to be provided at existing siphons so as to realize the full effect of the enlargement. These and other required structural modifications are discussed in paragraph (d), below.

After structural modifications, the capacity of the Canal in Sections 5 through 9 would meet the peak demands expected to be placed on it through the year 2020. The anticipated effects of the proposed enlargement and modifications are summarized in Table 32 and shown on Plate 11.

TABLE 32

EFFECT OF CONTRA COSTA CANAL MODIFICATIONS

Canal Section	Present Design Flow, cfs	Carrying Capacity After Modification, cfs		Year 2020 Peak Demand, cfs
		With Section Enlargement	With Structural Modifications	
5	291	455	715	676
6	269	440	695	676
7	256	480	620	615
8	225	415	585	505
9	204	510	565	474

b. Sections 3 and 4. As is shown on Plate 11, it is anticipated that the present design carrying capacity of Sections 3 and 4 of the Contra Costa Canal would be exceeded by about 1973, if improvements were not provided.

After the Kellogg Unit or alternate is constructed, service through Sections 3 and 4 will no longer present a problem. As is shown on Plate 6, the Laurel Canal will conduct water supplied from Kellogg Reservoir via the Contra Loma Canal to a terminus at Pumping Plant Number 4 of the Contra Costa Canal. From that point, water will flow westerly to meet service demands in Section 4, and easterly back through Section 3 to meet demands in that section. Requirements in the remainder of the Contra Costa Canal system will be supplied by deliveries from Kellogg into Contra Loma Reservoir and thence into Section 5 of the Contra Costa Canal, enlarged as described above. Thus, the entire present capacity of Sections 3 and 4 can be used to meet peak demands in these sections, without having to transfer water through to meet downstream demands.

At the present time, the schedule of construction of the proposed Kellogg Unit is not known, although it is unlikely that the project can be completed before 1975. If Kellogg is not delayed unduly, Sections 3 and 4 can probably be operated for a few years beyond 1973 by encroaching on Canal freeboard and, if necessary, by meeting part of the summer day peak flows by releasing from storage in Contra Loma Reservoir. Neither of these measures are recommended operating procedure in any but emergency circumstances. If Kellogg is delayed beyond about 1976 it will be necessary to enlarge Sections 3 and 4.

c. Sections 1 and 2. There are no demands at the present time on Sections 1 and 2 of the Contra Costa Canal, the unlined intake sections, nor are any demands anticipated in the future. After the Kellogg Unit is completed, the Bureau of Reclamation proposes to continue to operate the Rock Slough intake when water of suitable quality is available at that point, since the pumping requirements would be less than for water delivered through Kellogg Reservoir.

It is possible that water of suitable quality for municipal and industrial purposes will be available so rarely at Rock Slough after the Peripheral Canal is constructed and the State Water Project and the Federal Central Valley Project become fully developed, that the amount of water diverted from that source would not justify the maintenance costs of the main pumping plants and Sections 1 and 2. Furthermore, as will be explained in paragraph (f), below, there are physical problems which would limit the amount of water which could be pumped from Rock Slough into the enlarged Section 5 of the Contra Costa Canal without extensive modifications to the system. These considerations may make the continued use of the Rock Slough intake infeasible for even a portion of the long range supply to the study area.

The delivery capacity of Sections 1 and 2 is controlled by the water level in Rock Slough and the rate of pumping at Pumping Plant Number 1. The capacity in these sections should normally not present an operating problem, unless the flow velocities become high enough to cause bank erosion. If this occurs, the flow cross-section of the intake channel may have to be enlarged by widening and deepening.

d. In-line Structures. Structures which are located in the Canal flow section and affect the flow of water are termed in-line structures. These include checks, siphons, turnouts, trashracks, and wasteways. Most of these structures would require modification concurrently with Canal enlargement.

There are 12 check structures in the Contra Costa Canal between Sections 5 and 9. All of these would have to be enlarged to accommodate the increased flow depth of the Canal. In addition, the gates in the check structures would be motorized so as to be compatible with the proposed supervisory control system described later in this section of the Report. Also, when the Canal is enlarged, stilling wells would be installed at each check structure to accommodate the water level sensing units which would be provided as part of the supervisory control system.

The inlet and outlet transitions at eight existing siphons would be heightened to be compatible with the enlarged Canal section. As mentioned previously, the capacity of these siphons would have to be increased by about year 1992 in order to realize the full effect of the proposed Canal enlargement. This would be accomplished by adding a second barrel to each of the siphons. The transition sections and approach channel modifications required for these second barrels would, however, be installed at the same time as the Canal enlargement, and would then be sealed with bulkheads until the second barrels are added. A third barrel would be needed at the Los Medanos siphon.

Nine new siphons would be required at road crossings where the modification of existing bridges or construction of new bridges to accommodate the enlarged section would not be practicable.

There are 22 existing turnouts in Sections 5 through 9 which are not now in use and from which service is not expected to be needed in the future. These turnouts would be plugged, since leakage through them is in some instances creating a hazard to the stability of the Canal embankment. Each of the 21 existing turnouts which are in use would be modified to remove all hardware from within the Canal flow section and to provide for individual slide gates, trashracks, and meter pits.

Trashracks would be provided across the enlarged Canal just upstream from the transition into the proposed Clyde-Martinez pipeline, and in the existing Canal in the Diablo Valley loop just upstream of the proposed 42-inch gravity pipeline beginning at the U.S. Naval Reservation boundary. These trashracks would be of the self-cleaning type to reduce maintenance costs.

There are two existing wasteways which would have to be modified to serve the enlarged Canal, the Los Medanos wasteway at the end of Section 5 and the Nichols wasteway at the end of Section 8. The capacities of these facilities would be increased consistent with the increase in capacity of the respective main Canal sections. The wasteways would be provided with motorized gates so that they can be operated remotely through the proposed supervisory control system.

e. Cross Structures. Structures crossing the Contra Costa Canal include bridges, culverts, and overchutes. Bridges would be raised in most instances, or replaced by siphons where raising would not be a practicable solution. Culverts and overchutes providing drainage of the right-of-way would be modified or added new as necessary to be compatible with the enlarged Canal. In order that the general surface drainage around the Canal be conveyed to a culvert or overchute rather than discharging directly into the Canal, a system of interceptor and conveyance ditches would be provided.

f. Section 4 Terminal Structure. A structure would be required to physically separate Sections 4 and 5 after enlargement of the Canal and construction of the Kellogg Unit, so that water supplies released from Kellogg could pass into Section 5, at a substantially higher water surface level than in Section 4, without backfeeding. Gates would be provided so that backfeeding could be accomplished if desired.

As mentioned previously, the Bureau of Reclamation proposes to use the Rock Slough intake to provide a portion of the supplies to the study area even after the Kellogg Unit is constructed, so as to minimize total system pumping costs. However, this could only be accomplished with the existing facilities when the required water level in the enlarged Canal downstream of Contra Loma would be equal to or less than the maximum attainable water level at the terminus of Section 4. This situation would occur less and less frequently in the future. The alternative would be to enlarge the Canal through Sections 3 and 4 or to construct a fifth main pumping plant to lift the Rock Slough supplies over the terminal barrier at Section 4. The feasibility of either of these alternatives should be carefully examined before they are undertaken.

4. PUMPING PLANT ENLARGEMENT

As was stated in Section VI-A.2, the present installed capacities of the four main pumping plants in the Contra Costa Canal will be exceeded by 1971 unless new units are provided. Each plant is capable of receiving one new pump unit in addition to the five presently installed. This unit should have the ability to bring the total capacity of each plant up to the carrying capacity of the Canal section into which it discharges, and in addition to provide excess capacity to meet peak demands prior to the time the Kellogg Unit is operational, as described previously in the discussion of augmentation of Sections 3 and 4. For this purpose, the new units should have a capacity of 100 cfs each. In order to avoid encroaching on the Canal freeboard in Sections 3 and 4 except when absolutely necessary, the new units should also be capable of delivering only 50 cfs each at good efficiency. This could be accomplished by provision of variable-speed prime movers. A further advantage of being able to produce either 50 cfs or 100 cfs through the new units would be that these capacities closely parallel the capacities of the largest and smallest units now installed at each main pumping plant. Thus, during off-peak months, the new units could provide standby capability well matched to the existing configuration of the system.

In addition to the installation of new pumping units, some modernization of the existing electrical control equipment and substations at the pumping plants should be undertaken. However, investments for such modernization should be held to the minimum necessary to ensure reliable service over the coming 10-year period, in view of the uncertainty as to the long-range utility of the Rock Slough intake and the main pumping plants.

5. CANAL SAFETY

Improved fencing should be provided throughout the Canal to effectively prevent access to the waterway by unauthorized persons, in order to lessen the problem of Canal safety described in Section VI-B.1. Such fencing will be required on both sides of the Canal from Section 3 through Section 9.

The type of fencing arrangement recommended is shown on Plate 15. In the enlarged Sections 5 through 9 of the Canal, the fence should be located at the break in slope of the berm at the top of the new lining; it should be similarly placed on the berm above the existing lining in Sections 3 and 4. Throughout the Canal an asphalt surface should be placed beneath the fence, covering the berm and up the embankment slope to a point about one foot above the bottom of the fence, as shown on Plate 15. This arrangement would reduce the problems of weed control along the berm and around the fence, and would eliminate the possiblity of wash holes being formed beneath the fence through which small children could find access to the Canal.

The fencing should consist of 72-inch chain link fence. Gates with locks should be provided as necessary at structures for access by operating personnel, and also at all points where escape ladders are provided in the Canal. The fence should be brought continuously across the Canal at all structures in order to provide complete enclosure of all water surfaces. Insofar as possible, the fencing program should be aimed at making the Canal as inaccessible to small children as possible.

In addition to fencing, Canal safety should be improved through provision of means by which adults who fall into the Canal can get themselves out. Escape ladders should be placed on the lining both upstream and downstream of all structures, and at other locations where frequent access to the Canal is probable. Under no circumstances should the spacing between ladders exceed ¼ mile. Grates should be placed over the intake to all siphons and culverts. Floating lifelines should be placed across the Canal just upstream of the siphon and culvert inlets.

Installation of fencing and safety devices in Sections 3 and 4 of the Canal should be undertaken immediately. In Sections 5 through 9, installation of safety features should be deferred until after the proposed Canal enlargement has been completed.

6. SUPERVISORY CONTROL

After the Contra Costa Canal has been modified and improved as described previously, a supervisory control system should be operational which would permit remote operation of the entire Canal system from a single operations center. Components of the supervisory control system would include telemetering equipment to provide information on water level, inflow, outflow, and similar data at Contra Loma, Ygnacio, and Martinez Reservoirs and at the Shell Hill tank; and equipment to permit remote operation of all motorized checks and wasteways, inlet and outlet works to reservoirs, and pumping plants in the system. Development of the supervisory control system may take place over a period of time, with initial facilities perhaps being required as early as 1970. Remote operating equipment should not, however, be installed at the existing four main pumping plants in the Contra Costa Canal unless it becomes apparent in the future that substantial use will continue to be made of these plants after the Kellogg Unit is completed. Water level sensing units would be provided in stilling wells constructed at each check structure, which would relay information on water levels in the system canals. Gate openings at the check structures would similarly be relayed to the operations center.

An important component of the supervisory control system would be information on flow rate to each of the District's major customers. Equipment should be installed which would provide the operations center with data as to the status of each of the 20 present turnouts to the major customers, and of any similar principal turnouts which may be added in the future. Such equipment may be included as a part of the proposed new metering equipment described later in this section of the Report.

A supervisory control system of the type described briefly above would greatly improve the operating problems discussed in Section VI-A.3 and would permit much closer operating control on the water supply system as a whole than is possible under present manual procedures. In addition, operation and maintenance costs for the system would be greatly reduced from present levels. The supervisory control system should be capable of being expanded to include operation of the proposed Kellogg Unit.

A detailed analysis of the type of control system and the individual components to be employed is beyond the scope of this Report. An investigation of this type should, however, be undertaken as soon as possible. The supervisory control systems now being installed in the Bureau of Reclamation's Tracy Pumping Plant and Delta-Mendota Canal and in the Department of Water Resources' Delta Pumping Plant and California Aqueduct should be reviewed as to their effectiveness after they have begun operation.

During the interval prior to completion of the supervisory control system and other Canal system improvements discussed herein, present Canal operating procedures should be reviewed to determine possible methods of improving service.

7. METERING SYSTEM

As discussed previously in Section VI-B.3, the District's present metering system is generally adequate for the purposes it now serves, with some exceptions of meter reading and maintenance. However, in the case of the facilities serving the 15 major customers, improvements should be provided which would permit the meters measuring flow to these customers to become integral components of the proposed supervisory control system described above.

A companion report to this Master Plan Report analyzes the District's foreseeable financial requirements and proposes a rate structure for water sales. The proposed rate structure for the District set forth in that report would be of the "demand-commodity" type, wherein a major customer's monthly bill would be a function not only of his total water use but also of the peak flow rate at which he would receive his supplies. The objectives of such a rate structure would be to more equitably distribute the cost of water supply among the customers, and to encourage customers to reduce peaking on the Canal system as much as possible.

In order to institute a demand-commodity rate structure, additional equipment would be required for the metering system. Such equipment could readily be combined, at little additional cost, with the improvements which would be necessary for the supervisory control system.

Although a detailed investigation of the type of equipment which would be required for the proposed improvements to the metering system is not within the scope of this Report, the improvements would generally include telemetry, recording, and display at a control center of the diversions by major customers. An investigation of the improvements needed should be undertaken in the near future, since the demand-commodity rate structure must be put into practice at an early date if it is to be effective in reducing peaking on the Canal. For conservatism in planning, the proposed improvements to the Canal system have been scheduled in this Report without consideration of the possible effects of the metering system in reducing Canal peaking.

B. PARK AND TRAIL SYSTEM

The East Bay Regional Park District has indicated an interest in developing the right-of-way of the improved Contra Costa Canal system as a complex of recreational parks and trails, to be integrated into an over-all Contra Costa-Alameda County trail system now being established by the Park District. Types of use proposed would include bicycling, hiking, and horseback riding. The right-of-way would be improved with plantings of shrubs and trees, with the objective of creating a scenic green belt. Such a system would be extremely desirable if public safety could be ensured in those areas adjacent to the enlarged open Canal, and provided that the quality of Canal water could be effectively protected.

The Park District has indicated that it would take responsibility for all right-of-way development and maintenance, including development of all necessary supporting facilities; would be responsible for patrol of the trail system and for the safety of all recreation users as well as its own employees; and furthermore would assume all liability for injuries to such recreationists and employees. Such conditions would be necessary prerequisites to an agreement permitting recreational use of the Canal system right-of-way.

It is probable that the park and trail system would be developed first along the filled portion of the Canal in the Diablo Valley Loop, with development along the enlarged Canal upstream from Clyde occurring at a later date.

9. SEASONAL BARRIER AT ROCK SLOUGH

As was mentioned in Section VI-A.1, one of the two periods in the year when the quality of water in the Delta at Rock Slough frequently falls below desirable limits for municipal and industrial purposes occurs in the winter, when the chloride ion content of Rock Slough water has exceeded 100 ppm for an average of about 80 days each year. In this period, the quality of the water along the north shore of the District is usually good, due to heavy fresh water inflows in the Sacramento River which prevent brackish water from San Francisco Bay from intruding into the Delta, and which dilute the poor-quality flows in the western reaches of the San Joaquin River. Thus the chloride ion content of the offshore waters is usually lower during this period than that of the District's supplies at Rock Slough. In order to take advantage of this situation, it is proposed that a connection be made between Section 2 of the Contra Costa Canal and Fox Slough, as shown on Plate 16. Fox Slough is tributary to Dutch Slough, which frequently contains better quality water during the spring than does Rock Slough.

Under the proposed plan, the existing fish screen at the head of Rock Slough would be replaced by a control facility containing slide gates and tidal flap gates, and a new facility containing similar control features would be installed at the interconnection with Fox Slough.

At times when Fox Slough water would be desirable, this latter control facility would be open, and flows would enter the intake channel for pumping into the Canal system, with some flushing into Rock Slough being permitted through the tide gates. At other times, supplies would be drawn directly from Rock Slough as at present.

This facility would provide interim improvement of water quality in the Contra Costa Canal system in the years prior to completion of the Kellogg Unit, but may not be needed after that time. It should therefore be installed as soon as possible in order to provide maximum benefit.

B. LONG RANGE IMPROVEMENTS (BEYOND 1980)

Improvements now foreseeable which will probably be required on the Contra Costa Canal system after year 1980 have already been mentioned briefly in the discussion of near term improvements. These include possible installation of a booster pumping plant on the Clyde-Martinez pipeline and provision of additional barrels on the siphons in Sections 5 through 9 of the Canal.

Further consideration should be given to the need for additional emergency storage within the District service area as the water use within this area increases in the future. Although the expenditures necessary to provide for some limited storage at the Nichols reservoir site, or alternate sites, would be substantial, future system reliability may require the provision of such storage.

C. IMPROVEMENTS BY BUREAU OF RECLAMATION

1. IMPROVEMENTS TO CANAL

The United States Bureau of Reclamation is contemplating a number of improvements to the Contra Costa Canal system in an effort to relieve some of the current operating problems and to reduce operating costs. Much of the Bureau's program is identical to that previously described in this Report, although some aspects of it are believed to be either unwarranted or premature if undertaken at the present time. A schedule of the improvements proposed by the Bureau, and the anticipated expenditure through fiscal year 1970 are shown in Table 33. The total cost of the Bureau's program would amount to about $1.4 million.

Included in the planned improvements to the Canal are provision of motorized gates at eight of the check structures upstream from the Clyde turnout, provision of motorized facilities at Los Medanos and Nichols wasteways, and installation of a self-cleaning trashrack to replace an existing manually-maintained trashrack near mile 26. Installation of the motorized checks has been completed. These facilities would be integrated into a supervisory control system which would improve operational control of the Canal and reduce operating costs.

The motorized checks recently installed by the Bureau in the existing Canal will not be suitable for use in the enlarged Canal, and the proposed motorized wasteways and self-cleaning trashracks would not be compatible either. It is therefore recommended that further work on these improvements be deferred until after the Canal is enlarged.

2. IMPROVEMENTS TO PUMPING PLANTS

Improvements planned by the Bureau for the four main pumping plants in the Canal system are: installation of a sixth unit having 70 cfs capacity at each plant; replacement of existing obsolete and unsafe electrical control equipment; construction of new electrical substations at each pumping plant in order to accommodate the planned new pumping units and remedy existing low voltage problems; and structural modification of the pumping plants to provide a passage between pump bays so as to guarantee against a trashrack becoming plugged and starving a pump.

New units should be installed in Pumping Plants 1 through 4 in the near future; however, these should be variable-speed units capable of operating efficiently at capacities of 50 and 100 cfs. Because the desirability of maintaining the main pumping plants in service after the Peripheral Canal goes into operation is not certain, investments in new electrical equipment should be kept to the minimum necessary to ensure system reliability and

TABLE 33

SCHEDULE OF IMPROVEMENTS
PROPOSED BY
UNITED STATES BUREAU OF RECLAMATION

Proposed Improvement	Anticipated Expenditure, Dollars Fiscal Year 1967	Fiscal Year 1968	Fiscal Year 1969	Fiscal Year 1970
Motorize checks 1-8	60,745	60,745		
Motorize wasteways			11,800	
Self-cleaning trashrack			85,000	
Install new pump units				200,700
Replace electrical control equipment		156,200		
New electrical sub-stations		136,100		
Interconnection of pump bays			60,000	
New shop and service building			40,000	
Remote control checks 1-8				305,000
Remote control pumping plants 1-4			88,600	
Remote control Contra Loma Reservoir			38,000	
Martinez Reservoir telemetry			19,000	
Stilling wells at checks 1-8			22,300	
New operations building			87,500	
Total	60,745	353,045	452,200	505,700
Grand Total	1,371,690			

Source: U. S. Bureau of Reclamation data.

safety. Interconnection of the pump bavs guards only against the unlikely occurrence of plugging of one of the trashracks, and should not be undertaken until the remaining life of the pumping plants is known with more certainty.

3. SUPERVISORY CONTROL

In order to reduce Canal operating costs, the Bureau proposes a complete supervisory control system. This would include remote control of eight of the 12 checks and the two wasteways upstream of Clyde, the four main pumping plants, and Contra Loma Reservoir inlet and outlet works. Telemetering equipment to relay inflow, outflow, and water level data from Martinez and Contra Loma Reservoirs to an operations control center would also be included. Construction of stilling wells would be required at each of the eight check structures in order to accommodate water surface level sensing units in the control system.

The supervisory control system now contemplated by the Bureau for installation in the existing Contra Costa Canal system would not be extensive enough to accommodate the type of operation which will be required in the future after completion of the Kellogg Unit, the Clyde-Martinez pipeline, the Diablo Valley Loop, and the Canal enlargement in Sections 5 through 9. Any control facilities installed should be compatible with a future, more extensive, system.

4. OPERATING CENTER

In order to more centrally locate the operating force, to improve inadequate facilities for operations headquarters, and to provide a location for the proposed supervisory control system, the Bureau plans construction of a new operations building and subsidiary shop and service buildings at a site just below Contra Loma Dam. In view of the inadequacies of the present shop and maintenance buildings at Pumping Plant Number 4, and the need to undertake certain portions of the supervisory control system and metering system improvements in the near future, the new operating center should be constructed as now scheduled. However, since the District will probably be taking over responsibility for operation and maintenance of the Canal system in the near future, as discussed in Section X of this Report, it should have the right to full review and approval of all details of the proposed facilities prior to construction. Full consideration should be given in the design of the operating center to future District operating needs, esthetic requirements of the Contra Loma site, and potential visitation by the public.

D. SCHEDULE FOR DEVELOPMENT

The recommended schedule for development of the proposed improvement program is summarized in Table 34. Those aspects of Bureau's modernization program which would be suited to the overall development plan are included in this table. Stages I and II of the Canal Safety program listed in Table 34 refer to improvements in Sections 3 and 4 and to those in Sections 5 through 9 of the Canal, respectively. Similarly, Stages I and II of the Park and Trail System refer to developments along the Diablo Valley Loop and along the enlarged Canal, respectively.

The proposed improvement program for the Contra Costa Canal system is shown schematically on Plate 17.

TABLE 34

RECOMMENDED DEVELOPMENT SCHEDULE FOR PROPOSED IMPROVEMENT PROGRAM CONTRA COSTA CANAL SYSTEM

Year of Completion	
1968	1. USBR Modernization Program a. Motorize checks. b. New control equipment at Pumping Plants 1-4. c. New substations at Pumping Plants 1 and 4.
1969	1. USBR Modernization Program a. New shop and service building. b. New operations building. c. New pump units at Pumping Plants 1-4.
	2. Seasonal Barrier at Rock Slough
	3. Canal Safety - Stage I
1970	1. Clyde-Martinez Pipeline
	2. Metering System Improvements
1971	1. Diablo Valley Loop Improvements
	2. Park and Trail System - Stage I
1975	1. Canal Enlargement, Sections 5-9
	2. Canal Safety - Stage II
	3. Supervisory Control System
1976	1. Park and Trail System - Stage II
After 1980	1. Clyde-Martinez Booster Pumping Plant
	2. Siphon Enlargement, Sections 5-9

VIII. COST OF IMPROVEMENTS

A. NEAR TERM

The anticipated capital costs of the various features of the improvement program proposed for near term development are summarized in Table 35. Cost estimates shown for features of the Bureau of Reclamation's modernization program were taken from Bureau data, except for the cost of the new pumping units at Pumping Plants 1 through 4. The costs for these units shown in Table 35 are for units with two-speed drive motors capable of delivering 50 and 100 cfs at design operating head.

Cost estimates taken from Bureau data are believed to include additives of 25% for contingencies and 25% for engineering, which includes Regional and Denver Office costs. For other items shown in Table 35, including the proposed pumping units, factors have been added amounting to 15% for contingencies and 12% for engineering and administration, based on probable District costs.

The value of $66,000 indicated for improvements to the metering system is largely for equipment needed to incorporate the major customers' meters as part of the supervisory control system. The proportion of this amount which would be incurred specifically for the purpose of instituting a demand-commodity rate structure amounts to only about $10,000. No cost estimate has been made for a complete supervisory control system. The amount which the Bureau has scheduled for such a system totals $450,600, including remote control of the checks and wasteways upstream of Clyde, the four main pumping plants, and Martinez Reservoir; and telemetry from Martinez Reservoir.

The value shown in Table 35 for the cost of enlargement of the Canal from Section 5 through Section 9 includes allowances for all necessary structural modification and cross-drainage, and also includes provision for a trashrack upstream of the intake to the Clyde-Martinez pipeline, stilling wells at the check structures, and motorizing of wasteways. The cost of trashracks in the Diablo Valley Loop system are included in the total cost estimate for that improvement.

TABLE 35

ANTICIPATED COSTS OF NEAR TERM IMPROVEMENTS
CONTRA COSTA CANAL SYSTEM

Dollars

Item	Cost[a]
USBR Modernization Program:[b]	
Motorize Checks	122,000[c]
Control Equipment at Pumping Plants 1-4	156,000
Substations at Pumping Plants 1 and 4	136,000
Shop and Service Building	40,000
Operations Building	88,000
Pump Units at Pumping Plants 1-4	250,000
Sub-total	792,000
Seasonal Barrier at Rock Slough	96,000
Canal Safety - Stage I	354,000
Clyde-Martinez Pipeline	1,546,000
Metering System Improvements	66,000
Diablo Valley Loop Improvements	2,700,000
Canal Enlargement, Sections 5-9	6,250,000
Canal Safety - Stage II	935,000
Supervisory Control System	d/
Park and Trail System	e/
Sub-total	11,947,000
Grand Total	12,739,000

a/ Includes 15% contingencies and 12% engineering, except for USBR modernization program which is believed to include larger additives. All costs are estimated at 1967 price levels.

b/ Source: U. S. Bureau of Reclamation data, except for pumping units.

c/ Includes $61,000 already expended in fiscal year 1967.

d/ Not estimated.

e/ Not an expense of the Contra Costa County Water District.

B. LONG RANGE

Costs for anticipated long range improvements have not been analyzed in detail. Addition of second barrels to the siphons from Section 5 through Section 9 of the Canal is estimated at about $575,000. A booster pumping plant on the Clyde-Martinez pipeline would probably require about 1,500 horsepower installed capacity to meet all future needs to the year 2020 if reclamation of waste water in the area cannot be achieved. A plant of this size would cost about $475,000, including engineering and contingencies. Costs quoted above are for 1967 price levels.

IX. SOURCE WATER COSTS

A. PRESENT

Under the terms of the District's contract with the United States Bureau of Reclamation, Number I 75r-3401, the District may purchase up to 86,000 acre feet annually from the Central Valley Project for delivery through the Contra Costa Canal, at the rate of $10.00 per acre foot for municipal and industrial water supplies and $3.50 per acre foot for agricultural water supplies. These rates will apply during the term of the contract, which expires December 31, 1991, unless the contract is re-negotiated by mutual consent before that date.

B. FUTURE

The draft of the feasibility report supporting the proposed Kellogg Unit, now being reviewed at the Washington level, indicates that the water rates to the District from the project would be $10.00 per acre foot for municipal and industrial water deliveries up to 86,000 acre feet, and $18.00 per acre foot for deliveries over 86,000 acre feet up to 195,000 acre feet. Rates for agricultural water deliveries would be $3.50 per acre foot in the area served by the existing Contra Costa Canal, and $10.00 per acre foot in the additional area to be serviced by the Kellogg Unit. The rates for municipal water deliveries beyond 195,000 acre feet have not been indicated, but would probably be greater than those quoted above. The increase would be necessary to pay for the District's share of the costs of the additional storage units required in the Federal Central Valley Project system.

The repayment rates quoted above were derived from studies conducted by the Bureau of Reclamation based on the construction and operating cost estimates for the Kellogg Unit set forth in the draft of the feasibility report. These estimates were in turn determined using 1962 levels for wages and prices. According to information received from the Regional Director, Region 2, United States Bureau of Reclamation, by letter dated January 19, 1968, these tentative rates will be revised upward in the final report to be submitted to the Bureau of the Budget and to Congress. Information obtained from the Bureau of Reclamation in February 1968, indicates that the current estimated cost of the Kellogg Unit is $77.6 million.

It is considered probable that the charges for water from the Kellogg Unit will be substantially greater than hitherto estimated. However, definitive information is not available from the Bureau of Reclamation at this time.

An updated repayment analysis was made for the purposes of this Report, in which all capital costs were escalated to year 1973, assuming construction of Kellogg would begin in 1971 and end in 1975. Annual operating cost estimates were escalated to year 1976, the assumed first year of operation of the facility. For this analysis, it was assumed that use of the Rock Slough intake would be discontinued upon completion of the Kellogg Unit. Energy costs for pumping water supplies at Kellogg were increased to reflect this assumption. For a conservative analysis, it was assumed that no new irrigation would develop, and that all costs of Kellogg allocated to the irrigation function would have to be repaid by the District through municipal and industrial water sales, and would bear interest at the rate of 3½% annually.

It was found that a water charge of about $24 per acre foot would have to be assessed on all deliveries in excess of 86,000 acre feet in order to repay all costs of the Kellogg Unit within 50 years at 3½% interest. This charge would include $2 per acre foot to repay the costs of upstream storage facilities in the Federal Central Valley Project necessary to make 195,000 acre feet annually available to the District. For conservatism, this analysis was carried out assuming that water purchases from the CVP would be equivalent to those shown in Table 21 for "wet year" cnditions of offshore water supply in all years; i.e. assuming minimum sales of water from the Canal system within the present District service area. If water sales under "median year" conditions are assumed, the water charge for repayment would need to be only about $20 per acre foot, and the figure would be $17 per acre foot under "dry year" conditions.

X. DISTRICT OPERATION OF CANAL SYSTEM

A. PURPOSE OF ANALYSIS

The United States Bureau of Reclamation has indicated its intention to transfer the responsibility for the operation of the Contra Costa Canal system to the District, probably effective as of the date of completion and initial operation of the proposed Kellogg Unit. District responsibility would encompass all facilities downstream from the outlet works of Kellogg Reservoir. This transfer would be desirable, since properly coordinated operation is difficult under the present arrangement whereby the Bureau operates the Canal but the District is responsible for distribution system operations, water sales, and orders. This situation inevitably results in operating difficulties and delays, and in unnecessary duplication of effort. A procedure which would be more efficient and responsive to customers' needs could be attained if one agency were to be responsible for all operations.

In order to estimate the economic effect of the transfer, an analysis has been made of the probable cost to the District of assuming responsiblity for operation and maintenance of the Contra Costa Canal system. The assumption has been made that the District would operate the system in essentially the same manner as the Bureau has in the past, but that some additional costs would be incurred due to needed improvements in the operation. It has also been assumed that the District would be able to purchase pumping energy from the Federal Central Valley Project at the rate of 0.25 cents per kilowatt-hour currently charged to the Contra Costa Canal Unit.

B. HISTORICAL O & M COSTS

1. COSTS TO BUREAU OF RECLAMATION

In order to estimate the costs which would be incurred by the Contra Costa County Water District in operating and maintaining the Contra Costa Canal system in the future, the historical O & M costs incurred by the United States Bureau of Reclamation were examined. These historical costs from fiscal year 1958 through 1966 are shown in Table 36, separated as to the Canal itself and the main pumping plants. The Canal portion includes O & M costs for the Ygnacio and Clayton Relift Canals and Pumping Plants.

The historical Bureau total labor costs were broken down into estimated components for Contra Costa Canal system base operating personnel, costs for temporary labor and specialty labor provided from Tracy, and supervision and engineering costs from Tracy. This breakdown, shown in Table 37, was based on detailed data for hours and costs by each category for fiscal years 1958 and 1961 and on data on hours for each category for fiscal year 1967, applied to recorded total costs for the other years.

2. HYPOTHETICAL DISTRICT COSTS

In reconstructing the historical operation and maintenace costs from 1958 through 1966 as they would have been if the District had been responsible for O & M rather than the Bureau of Reclamation, the first step was to determine the labor costs which the District would have incurred. An analysis was made of the duties involved for each job classification included in the Contra Costa Canal system base operating staff, and the annual salary which the District would have to pay to fill each position was estimated by comparison with typical wage rates now paid by various local, County, and State agencies. Fringe benefits and overtime pay allowances were similarly analyzed. This comparison indicated that for base labor costs in 1967, the District would have to pay about 20% more than the amount budgeted by the Bureau of Reclamation. Annual leave and certain other fringe benefits would, however, be greater under the Bureau's salary scale. The hypothetical base labor costs which the District would have incurred from 1958 through 1966 were therefore derived by multiplying the estimated historical Bureau costs for base and temporary labor by a factor of 1.2.

TABLE 36

HISTORICAL OPERATION AND MAINTENANCE COSTS FOR CONTRA COSTA CANAL SYSTEM

Dollars

Fiscal Year	Labor a/	Administration b/	Motor Vehicles	Other Equipment	Material & Supplies	Other Expense c/	Travel & Per Diem c/	Contracts, Agreements & Services c/	Power d/	Total
					Contra Costa Canal					
1958	95,493	15,767	16,291	7,744	22,910	35,286			3,244	196,735
1959	115,203	8,640	22,905	8,577	13,193	19,533			4,597	192,648
1960	117,734	7,064	19,385	5,760	6,823	27,827			4,188	188,781
1961	114,181	4,089	19,468	6,697	14,609	26,770			4,333	190,147
1962	119,107	7,264	18,666	6,475	25,120		0	1,900	4,677	183,209
1963	129,031	13,467	16,660	10,838	23,693		221	10,907	4,417	209,234
1964	158,700	21,871	20,220	6,297	36,501		92	1,194	4,725	249,600
1965	149,578	26,557	12,987	5,647	21,427		1,249	44,859	3,491	265,795
1966	145,521	46,969	13,516	10,982	36,404		257	614	3,759	258,062
					Main Pumping Plants 1-4					
1958	45,828	1,320	3,631	27	2,210	51			22,910	75,977
1959	55,815	1,350	5,004	61	2,789	439			27,657	93,115
1960	63,715	1,250	4,696	59	5,081	728			32,758	108,287
1961	77,843	1,162	4,676	273	8,310	900			35,397	128,561
1962	80,000	1,598	4,966	332	4,561		0	2,910	34,380	128,749
1963	72,697	1,497	3,604	48	4,408		0	910	28,276	111,440
1964	71,525	570	3,820	98	5,251		20	3,494	35,081	119,859
1965	68,158	121	2,559	400	6,816		118	1,082	34,134	113,388
1966	73,775	708	2,976	345	4,480		0	1,499	34,777	118,560

a/ Includes Tracy Field Division labor and supervisory costs.

b/ Includes Regional and Denver Office costs.

c/ Prior to 1962, "Travel & Per Diem" and "Contracts, Agreements & Services" were combined and reported as "Other Expense".

d/ Power cost for canal indicates costs for Clayton and Ygnacio Pumping Plants.

Source: U. S. Bureau of Reclamation data.

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TABLE 37

HISTORICAL LABOR COSTS FOR OPERATION AND MAINTENANCE OF CONTRA COSTA CANAL SYSTEM

Dollars

Fiscal Year	Tracy Division Costs				Total Costs
	Base	Temporary	Specialty	Supervision	
1958	130,321	1,700	4,100	5,200	141,321
1959	153,018	1,500	8,400	8,100	171,018
1960	157,349	700	13,200	10,200	181,449
1961	161,224	600	17,400	12,800	192,024
1962	166,107	1,900	14,600	16,500	199,107
1963	164,428	3,300	14,300	19,700	201,728
1964	185,525	5,600	14,700	24,400	230,225
1965	170,836	6,900	13,500	26,500	217,736
1966	173,596	7,700	12,000	26,000	219,296

Source: U. S. Bureau of Reclamation data.

Breakdown of costs by category of labor known for 1958 and 1961; estimated for other years from known total costs.

TABLE 38

HYPOTHETICAL DISTRICT LABOR COSTS FOR OPERATION AND MAINTENANCE OF CONTRA COSTA CANAL SYSTEM

Dollars

Fiscal Year	Base Labor	Contract Labor	Super-vision	Total Labor Costs	Total Costs Chargeable to Canal	Total Costs Chargeable to Pumping Plants	Percent Charged to Canal
1958	158,400	8,200	5,200	171,800	110,400	61,400	64
1959	185,400	16,800	8,100	210,300	135,600	74,700	64
1960	189,700	26,400	10,200	226,300	140,800	85,500	62
1961	194,200	34,800	12,800	241,800	137,500	104,300	57
1962	201,600	29,200	16,500	247,300	140,000	107,300	57
1963	201,300	28,600	19,700	249,600	152,200	97,400	61
1964	229,400	29,400	24,400	283,200	187,300	95,900	66
1965	213,300	27,000	26,500	266,800	175,500	91,300	66
1966	217,600	24,000	26,000	267,600	168,600	99,000	63
						Average	62

Specialty labor principally includes highly skilled electricians and mechanics for maintenance of the large pumping units. The Bureau of Reclamation can retain a number of employees of this type and assign them to work as needed throughout the Central Valley Project system. For maintenance of the Contra Costa Canal system alone, however, the District would have to obtain this type of labor from private contractors and would therefore have to pay greater overhead costs and profit in addition to direct salary costs. The District's hypothetical specialty labor costs were estimated at twice the actual costs incurred by the Bureau. District supervisory costs were taken as equal to historical Bureau costs.

The estimated total labor costs which the District would have incurred from 1958 through 1966 if it had been responsible for operation and maintenance of the Contra Costa Canal system are set forth in Table 38. Based on analysis of detailed Bureau labor cost data for 1958 and 1961, and on the relationships between Bureau costs and District costs described above, the total hypothetical District labor costs were distributed between those chargeable to Canal O & M and those due to pumping plant O & M, as shown in Table 38.

Costs for motor vehicle operation which the District would have incurred in operating and maintaining the Contra Costa Canal system from 1958 through 1966 were estimated from an analysis of recorded mileage logged by Bureau vehicles and the average charge per mile used by the District's Treated Water Division to fully amortize all costs. It was found that the District's costs for motor vehicle operation would be 40% higher than those reported by the Bureau. District charges for other equipment rental were estimated at twice those reported by the Bureau, based on hourly usage logged by the Bureau and unit rental rates quoted by local construction equipment rental agencies.

The estimated costs to the District for materials and supplies were taken as 10% more than the Bureau's recorded costs, and the District's costs for contracts and miscellaneous services were estimated at 10% less than the actual costs incurred by the Bureau. District administrative costs were estimated at 75% of the historical Bureau Regional and Denver Office costs. It was assumed that the District would be able to purchase power from the Federal Central Valley Project at 0.25 cents per kilowatt-hour, the same rate now charged by the Bureau against the Contra Costa Canal Unit.

The estimated total costs for operation and maintenance of the Contra Costa Canal system which the District would have incurred had it been responsible for O & M during the period 1958 through 1966 are summarized in Table 39. As estimated, these costs would have averaged 16% greater than actual Bureau costs for Canal O & M, and 22% greater for Pumping Plant O & M. The total combined District costs would have been 18% more than Bureau costs, on the average. Costs for power in the Canal portion of Table 39 are for the Clayton and Ygnacio Pumping Plants.

It should be stressed here that this comparison of historical costs is for study purposes only, and does not reflect the future costs which the District would bear on takeover of operation and maintenance. It is highly desirable that the District take responsibility for O & M of the Canal system at the proper time, in order to provide the best possible service to its customers and to eliminate duplication between the present activities of the District and the Bureau.

C. FUTURE COSTS

1. IMPROVED SUPPLY SYSTEM

It is probable that the United States Bureau of Reclamation will continue to operate the Contra Costa Canal system until the Kellogg Unit is completed and in operation, although improvements in the operating procedures will be required. By that time, the proposed improvement program for the Canal system presented in this Report should have been completed. These improvements would have a significant effect on the operation and maintenance costs of the system. In estimating the future O & M costs of the improved system, separate consideration was given to the enlarged Canal upstream from the TWD turnout, the Diablo Valley Loop, and the Clyde-Martinez pipeline.

The enlarged Contra Costa Canal upstream from the TWD turnout would require operation and maintenance as at present. The increased size of the flow section would not significantly affect O & M costs. This reach of the Canal, including Sections 1 through 4, is 26.4 miles in length, or about 46% of the total 57.7 miles of the

TABLE 39

HYPOTHETICAL TOTAL COSTS FOR DISTRICT OPERATION AND MAINTENANCE OF CONTRA COSTA CANAL SYSTEM

Dollars

Fiscal Year	Labor	Adminis-tration	Motor Vehicles	Other Equipment	Materials & Supplies	Services & Misc.	Power	Total
				Contra Costa Canal				
1958	110,400	11,800	22,800	15,500	25,200	31,700	3,200	220,600
1959	135,600	6,400	32,100	17,200	14,500	17,600	4,600	228,000
1960	140,600	5,400	27,100	11,500	7,500	25,000	4,200	221,500
1961	137,500	3,000	27,300	13,400	16,100	24,100	4,300	225,700
1962	140,000	5,500	26,100	12,900	27,600	1,700	4,700	218,500
1963	152,200	10,100	23,300	21,700	26,100	10,000	4,400	247,800
1964	187,300	16,500	28,300	12,600	40,200	1,100	4,700	290,700
1965	175,500	19,900	18,200	11,300	23,600	41,500	3,500	293,500
1966	168,600	35,300	18,900	22,000	40,000	800	3,600	289,400
				Main Pumping Plants 1-4				
1958	61,400	1,000	5,100	0	2,400	100	22,900	92,900
1959	74,700	1,100	7,000	100	3,100	400	27,700	114,100
1960	85,500	800	6,600	100	5,600	700	32,800	132,100
1961	104,300	900	6,500	500	9,100	800	35,400	157,500
1962	107,300	1,100	7,000	700	5,000	2,600	34,400	158,100
1963	97,400	1,100	5,100	100	4,800	800	28,300	137,600
1964	95,900	300	5,400	200	5,700	3,200	35,100	145,800
1965	91,300	100	3,600	800	7,500	1,100	34,100	138,500
1966	99,000	400	4,200	700	5,000	1,300	34,800	145,400

Contra Costa, Clayton, and Ygnacio Canals. For study purposes, the future O & M costs of this reach, occurring after completion of the Diablo Valley Loop, have been estimated at 50% of the costs for total Canal O & M, exclusive of power.

The United States Bureau of Reclamation proposes that operation of the four main pumping plants and the Rock Slough intake be continued after completion of the Kellogg Unit, diverting supplies from that source when available at suitable quality levels. In this case, the costs for Pumping Plant O & M would continue to be incurred, except that power costs would be reduced proportionately to the reduction in total annual diversions. If the pumping plants were abandoned, these costs could be avoided. In that case, however, energy costs for the Kellogg Unit would be increased over the Bureau estimates due to the increased amount of pumping into Kellogg which would be required.

Operation and maintenance costs of the proposed Diablo Valley Loop system would be much lower than would be the case with continuation of the present open canal system. These costs would include maintenance of pumping plants, storage facilities, and 7.9 miles of open canal to be retained in service in the United States Naval Reservation; energy costs for pumping; and replacement costs. These estimated annual costs are summarized in Table 40, at 1967 cost levels.

Maintenance costs for the Clyde-Martinez pipeline are conservatively estimated at $500 per mile, or about $2,500 annually.

The program for system improvements presented in which this Report proposes a supervisory control system which would permit remote operation of the entire Canal system. Supervisory control would greatly reduce operating costs for the portion of the Canal system through Section 9, and would also have some effect in reducing such costs in the Diablo Valley Loop system. The degree to which these operating costs would be lowered cannot, however, be foretold at present.

TABLE 40

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS FOR DIABLO VALLEY LOOP SYSTEM [a/]

Dollars

		Annual Cost[b/]
1.	Operation and Maintenance	
	a. Canals	40,000
	b. Pipelines	5,000
	c. Right-of-Way	6,000
	d. Pumping Plants	17,500
	e. Storage Facilities	3,500
2.	Replacements	2,500
3.	Pumping Energy	4,000
	Total	78,500

[a/] Without supervisory control system.

[b/] At 1967 unit cost levels.

TABLE 41

ADDITIONAL OPERATION AND MAINTENANCE COSTS FOR IMPROVED SYSTEM

Dollars

		Annual Cost[a/]
1.	Motorized Gates and Checks	2,000
2.	Supervisory Control System	9,000
3.	Surface Right-of-Way	10,000
4.	Landscaping	4,000
5.	Water Quality Testing	17,000
	Total	42,000

[a/] At 1967 unit cost levels.

2. ADDITIONAL COSTS

Some additional costs would be incurred in operation and maintenance of the improved Canal system as proposed in this Report, due to upgrading of certain aspects of maintenance and to maintenance of new equipment installed under the improvement program. These would include costs of maintaining the proposed motorized checks and the supervisory control system; improved maintenance of the surface right-of-way, including new landscaping; and the costs of an expanded water quality testing program. These estimated additional costs are summarized in Table 41. Although additional costs are shown for operation and maintenance of motorized gates and checks and for the supervisory control system, the net effect of these facilities would be to reduce total system O & M costs.

3. TOTAL FUTURE COSTS

In estimating the total future costs of operation and maintenance of the Canal system, it was assumed that the Bureau of Reclamation would continue to operate the system until completion of the proposed Kellogg Unit, and that thereafter the District would be responsible for operations. Historical trends of Bureau costs for Canal O & M and for Pumping Plant O & M were extended forward through year 1975, the assumed last year of Bureau operation of the system. Power costs at the main pumping plants were similarly extrapolated. For purposes of this analysis, it was assumed that the use of the Rock Slough intake and Pumping Plants 1 through 4 would be discontinued after completion of the Kellogg Unit.

The projected operation and maintenance costs for the Contra Costa Canal system through 1976 are listed in Table 42. After 1971, the scheduled completion date for the Diablo Valley Loop, the projected costs for O & M of the Contra Costa Canal were reduced by 50% in order to reflect only the estimated costs for the Canal upstream from the TWD turnout. Operation and maintenance costs for the Diablo Valley Loop system and additional costs for the improved system were taken from the data shown in Tables 40 and 41, escalated forward from 1967 levels at the annual rate of 4 per cent of the 1967 costs. Canal O & M costs for the year 1976, the assumed first

TABLE 42

PROJECTED OPERATION AND MAINTENANCE COSTS FOR CONTRA COSTA CANAL SYSTEM

Thousands of Dollars

Year	Main Pumping Plants 1-4[a/]	Contra Costa Canal[b/]	Diablo Valley Loop[c/]	Clyde-Martinez Pipeline	Additional Costs[d/]	Power[a/]	Total
1967	93	231				29	353
1968	96	236				33	365
1969	99	241				38	378
1970	102	246				42	390
1971	106	252				45	403
1972	109	128	94	3		49	383
1973	112	131	97	3		52	395
1974	115	134	100	3		55	407
1975	118	136	104	3		58	419
1976	0	161	107	3	57	0	328

Annual increase after 1976 = 5% x $328,000 = $16,400

[a/] Use of Rock Slough intake and Pumping Plants 1-4 assumed to be discontinued after completion of Kellogg Unit.

[b/] Reflects O & M costs only for Canal upstream from TWD turnout after 1971.

[c/] From Table 40, escalated forward from 1967 cost levels at 4% annually.

[d/] From Table 41, escalated forward from 1967 cost levels at 4% annually.

year of District operation, were taken as 16 per cent greater than they would have been in that year under Bureau operation, based on the comparison between historical Bureau costs and hypothetical District costs discussed previously in this Section.

Total costs to the District for operation and maintenance of the improved Canal system were assumed to escalate beyond year 1976 at a uniform rate equivalent to 5% of the 1976 total. This increase rate is comparable to that experienced in the past by the District's Treated Water Division for labor costs.

Estimation of the effect of the proposed supervisory control system in reducing O & M costs would require detailed analysis, and is beyond the scope of these studies. The reduction could be substantial; however, for conservatism, it has not been considered in this analysis.

XI. TREATED WATER SYSTEMS

A. PRESENT SYSTEMS

Most of the treated water consumed within the boundaries of the District is treated and purveyed by the seven large municipal water service agencies listed in Section II-A.2. Some of the important characteristics of these agencies' systems are listed in Table 43.

There are four groups and associations, serving a total of 22 customers, which treat Canal water for domestic use. A few individuals in the eastern portion of the County also treat water from the Canal for use in their homes. It is probable that all of these will eventually be served by the municipal service agencies as the agencies expand their service boundaries in the future.

B. FUTURE EXPANSION

1. EXISTING SYSTEMS

It is anticipated that the existing municipal water service agencies will continue to expand their systems as necessary to meet the growing demand for treated water in the study sub-areas which they serve, as shown in Table 43. The District's Treated Water Division is now completing the new Bollman Treatment Plant located at Mallard Reservoir. This facility will have an initial rated capacity of 50 mgd, with capability for future expansion to 250 mgd. The cities of Antioch, Martinez, and Pleasant Hill are also presently involved in major expansion and modernization programs.

TABLE 43

CHARACTERISTICS OF TREATED WATER SYSTEMS

Service Agency	Number of Services[a]	Rated Capacity of Treatment Plants, MGD	Total Finished Water Storage, MG	Sub-Area Located In
Oakley County Water District	530	4.3	0.4	Oakley
City of Antioch	6,600	10.0	2.5	Antioch
City of Pittsburg	6,000	6.0	6.3	Pittsburg
Bay Water Service	2,350	2.7	1.1	Nichols
Treated Water Division of CCCWD	33,000	31.0	27.5	Central County
City of Pleasant Hill	1,710	1.9	2.0	
City of Martinez	6,000	14.0	4.0	Martinez

[a] As of 1967.

Source: Contra Costa County Water District data.

2. NEW SYSTEMS

a. Byron Sub-Area. Demand for municipal water service in the Byron sub-area is not expected to grow to the point where a treated surface water supply would be justified in lieu of expanded ground water production until after 1980. When the demand for surface water supply does materialize, the source could probably be direct from Clifton Court Forebay or from Herdlyn Reservoir rather than from Kellogg Reservoir so as to avoid the necessity of pumping the supply to elevation 300. A new water district or an improvement district within Contra Costa County Water District could be formed serving treated water north to the vicinity of Marsh Creek Road or Indian Slough, from a treatment plant located near Clifton Court or Herdlyn Reservoir.

As an alternative, treated water could be delivered to the Byron sub-area from a treatment plant located in the vicinity of the existing Marsh Creek flood detention structure on Marsh Creek Road. This treatment plant would draw its raw water from Kellogg Reservoir, and would supply both the Byron and Brentwood sub-areas. This system could be operated through an improvement district of the Contra Costa County Water District. Final selection of the appropriate method of providing treated water service in the Byron sub-area must await feasibility-level studies.

The requirement for treated surface water service in this area may be accelerated by the development of a planned resort community in the Byron Tract between Clifton Court and Indian Slough. Plans for this community call for more than 12,000 medium- to low-density residential units at full development, which could have a water requirement of as much as 8 mgd on a summer weekend. The current plan proposes a ground water supply initially, but is extremely doubtful that this source could meet the needs of the community for domestic water at full development.

b. Brentwood Sub-Area. There is already sufficient demand to justify provision of treated surface water supplies in the Brentwood sub-area, and it can be expected that the City of Brentwood will request such service as soon as surface supplies are available from the Kellogg Unit. Treated water service in this area could be served by formation of an improvement district within the Contra Costa County Water District.

The most likely location for a treatment plant serving the Brentwood sub-area would be adjacent to the proposed Contra Loma Canal in the vicinity of Deer Creek or Sand Creek. Water treated at this location could be delivered by gravity to the City of Brentwood and other portions of the sub-area at low elevation, and could be pumped into the Lone Tree-Deer Valley area when residential development occurs there.

As an alternative, treated water could be delivered to the Brentwood sub-area from a treatment plant located at Marsh Creek. This plant could also serve the Byron sub-area, as mentioned previously. Selection of the appropriate method of providing treated water service in the area should be the subject of a feasibility-level study.

c. Islands Sub-Area. It can be anticipated that a sizeable resort community will develop in the Islands sub-area in the foreseeable future, particularly around the periphery of Bethel Island and along Dutch Slough and Sand Mound Slough. Treated water service from surface supplies will probably be required in that area before 1980. Such service could be provided either by an extention of the Oakley County Water District facilities or through the system to serve the Brentwood sub-area when such is constructed.

XII. FINANCING

A. PROCEDURE

Studies were carried out to determine the charges which would have to be levied per acre foot of water supplied from the Federal Central Valley Project in order to repay the anticipated costs of the proposed improvement program for the Canal system, together with associated operation and maintenance costs. Two approaches were examined: (1) assuming the Bureau of Reclamation would construct all of the improvements; and (2) assuming that the District would finance and construct all improvements except those listed in Table 35 as part of the Bureau modernization program, which would be constructed by the Bureau. It should be noted that the Canal system is Federal property, and that the consent of the United States would have to be obtained in order for the District to carry out improvements thereon.

In these studies, the following assumptions were made:

(1) Water purchases from the CVP were taken from Table 21 assuming "wet year" conditions of offshore water supply in all years; i.e. assuming minimum sales of water from the Canal system within the present District service area.

(2) After initial operation of the proposed Kellogg Unit, assumed to be in year 1976, revenues to repay the improvement program for the Canal system would be generated only on the first 86,000 acre feet of water sold each year. Revenues from water sales beyond this amount would be needed to repay the costs of the Kellogg Unit allocated to the District.

(3) The costs of the improvement program for the Canal system would include not only those costs shown in Table 35, but also the presently outstanding balance due on the Contra Costa Canal and the cost of the recently-completed Contra Loma Dam and Reservoir.

(4) The new water charges needed to repay the improvements would become effective starting in 1970.

(5) A "storage charge" of $2 per acre foot would be assessed by the Bureau to repay the costs of storage facilities in the Federal Central Valley Project. This charge would be in addition to charges levied to repay the improvements.

(6) The estimated cost of any improvements undertaken by the Bureau would bear additives amounting to 25% for contingencies and 25% for engineering and administration. Costs of improvements undertaken by the District would include 15% for contingencies and 12% for engineering and administration.

(7) Costs would be escalated from the 1967 levels shown in Table 35 to levels at the various times at which the improvements would be required, as shown in Table 34, at a uniform rate equivalent to 6 per cent of the 1967 costs.

(8) Obligations to the Federal Government would be repaid within 50 years from the time the facilities for which the costs were incurred were completed, and would bear 3¼% annual interest.

(9) Costs financed by the District through the sale of revenue bonds would be repaid within 35 years from the time incurred, with interest at 5½% annually.

(10) The District would be responsible for future O & M costs of the Canal system after 1976. Anticipated future O & M costs used in the studies were as shown in Table 42.

The costs of the supervisory control system proposed in the improvement program were not considered in the financial analysis, nor were the effects of such a system in reducing future expenditures for operations. Further study would be needed to determine the required components of a desirable control system, the cost of the system, and the expected savings in operating expenses. It is probable that these expenses could be substantially lowered, with a resulting reduction in the water charge.

The District is at the present time financially indebted to the United States for the construction cost of the recently-completed Contra Loma Dam and Reservoir, and for the presently outstanding balance due on the Contra Costa Canal. The final cost of Contra Loma has not yet been determined, but it will amount to about $4.5 million. This figure includes a substantial sum for acquisition of recreational lands adjacent to the reservoir, which would not be an obligation of the District. According to studies conducted by the Bureau, the unrepaid balance on the Contra Costa Canal at the end of fiscal year 1966 was about $10.6 million. These values have been used for the present purposes of this Report, although a careful review of the Bureau's analyses must be made before the District officially accepts them. Their use herein does not imply District acceptance. It was assumed that these existing obligations would be repaid in 50 years from the present date, at an interest rate of 3¼% per annum.

B. RESULTS OF ANALYSES

The analyses of the two methods of repayment described above indicated that whether the Bureau or the District financed the proposed improvements to the Canal system would make little difference to the required water charge. In the first case, interest costs would be lower and the repayment period would be longer, but the initial capital costs would be higher. The reverse would be true in the case of the District financing and constructing the improvements. Under Bureau sponsorship, a water charge of about $25 per acre foot on the first 86,000 acre feet purchased annually from the CVP would be required to repay all costs of the improvement program, including the $2 storage charge. This charge would be about $26 for the case of District sponsorship.

In Section IX of this Report it was stated that a repayment charge of from $17 to $24 per acre foot on all water supplies in excess of 86,000 acre feet per annum received by the District through the proposed Kellogg Unit of the Federal Central Valley Project would probably be sufficient to repay all costs of the Unit reasonably allocable to the District, including a $2 storage charge. For practical purposes, it may be desirable to combine the repayment of the Kellogg Unit and the improvements to the Canal system, assuming the Bureau of Reclamation would undertake construction of both. In this case a single water charge could be applied by the Bureau to all deliveries from the CVP, which would be adequate to repay Kellogg, the Canal system improvements as defined previously, and all operation and maintenance costs, within 50 years at 3¼% interest. An overall charge of from $20 to $25 per acre foot would accomplish this, depending on the assumed availability of offshore water supply. Under "median year" conditions of offshore supply, the repayment charge would be $22 per acre foot. Further charges would probably have to be assessed on deliveries in excess of 195,000 acre feet per annum in order to repay the costs of increased storage in the CVP system which would be properly chargeable to the District.

It should be pointed out that the water charges quoted in the preceding paragraphs are comparable to the $10 per acre foot now charged to the District by the Bureau for municipal water supplies, and are not to be confused with the water rates which the District sets on sales to its customers. These rates would be higher than the figures quoted above, to cover District operating expenses. Furthermore, if the District were to finance the improvements to the Canal system, bonding requirements might dictate water rates to customers somewhat higher than the water charges quoted above, at least during the earlier years of bond repayment.

It should further be stressed that all of the water charges quoted above, and also those quoted in Section IX for source water costs, were derived from repayment analyses which were based on the assumption that water use would be limited to the present District service area. This was a conservative assumption, to establish an upper limit to probable water charges. To indicate the range within which the actual charges would fall, a repayment analysis of the combined Kellogg Unit and the improvements to the Canal system was made, assuming Bureau construction of both, but with water use in the entire study area. This analysis showed that a water charge of from $17 to $21 per acre foot would be required for repayment, as against the range of $20 to $25 quoted above.

XIV. CONCLUSIONS

1. In recent years, the demand for water from the Contra Costa Canal system has approached the 86,000 acre feet which the United States Bureau of Reclamation is obligated to provide from the Federal Central Valley Project under the terms of its present contract with the District.

2. Although some high-quality supplies will be available in the future from the offshore waters in all but very dry hydrologic conditions in the Central Valley, the number of days of availability of these supplies in any year will be markedly fewer than has been the case in the past, particularly after the Peripheral Canal is in full operation.

3. The demand for water from the Contra Costa Canal system, including losses, is expected to reach 476,000 acre feet annually within the present District service area by the year 2020, under dry-year conditions of no availability of high-quality water from offshore. Under median-year conditions of offshore water supply, the year 2020 demand from the Canal system within the District would amount to about 430,000 acre feet.

4. The water demand figures for the total potential District service area, corresponding to those quoted above for the present District, are estimated at 593,000 and 547,000 acre feet under conditions of dry- and median-year offshore availability, respectively.

5. The present Contra Costa Canal system is not able to provide water supplies having mineral quality at all times suitable for municipal and industrial purposes. Historically, the chloride ion content of the supplies available at Rock Slough has exceeded the District's desired upper limit of 100 ppm 35 per cent of the time, and has reached as high as 374 ppm.

6. After construction of the Peripheral Canal, and as the Federal Central Valley Project and the State Water Project reach full development, the Rock Slough intake to the Contra Costa Canal system will not be able to provide a firm supply of even minimum quality water for municipal and industrial uses.

7. The District has reached an agreement with the Department of Water Resources under which the Department will provide monetary compensation for the reduction in availability to the District of high-quality water at Mallard Slough caused by the operations of the State Water Project. Monies paid under this agreement would be used to purchase substitute supplies from the Federal Central Valley Project. Such substitute deliveries cannot be made for more than possibily a few more years under the District's present water supply contract with the Bureau of Reclamation and with the capacity limitations of the existing Contra Costa Canal system. In recognition of this situation, the agreement was predicated on the assumption that the proposed Kellogg Unit would be constructed in the near future.

8. Under future conditions with the Federal Central Valley Project and the State Water Project in full operation, high-quality water supplies will be available at all times in the southeastern part of the study area in the vicinity of Clifton Court Forebay and the intake to the Tracy Pumping Plant.

9. The proposed Kellogg Unit of the Federal Central Valley Project would solve the problem of water supply to the District by making available up to 440,000 acre feet annually of water having 100 ppm or less chlorides. Of this amount, 195,000 acre feet is now allocated to the District from the existing Federal Central Valley Project; more storage units would have to be added to the Project to develop the remaining 245,000 acre feet or more which the Kellogg Unit could deliver. It may prove necessary to somewhat increase, during final design studies, the selected capacity of the Contra Loma and Laurel Canals above those now proposed by the Bureau of Reclamation, in order that the Kellogg Unit may fully satisfy the projected year 2020 requirements.

10. An excellent opportunity to substantially increase the high-quality water supply available to the District exists through reclamation of the effluent discharged from the Central Contra Costa Sanitary District's sewage treatment plant.

11. Desalting of the brackish offshore waters of the Sacramento-San Joaquin Delta and Suisun Bay presents the potential for meeting the District's long-range needs for water supply, although it does not now appear to be economically competitive with conventional surface supplies or with waste water reclamation.

12. The existing design capacity of the Contra Costa Canal will be exceeded in Sections 3 and 4 of the Canal by about year 1973, barring occurrence of wet-year conditions of offshore water supply which would reduce the summer peak demands on the Canal system. The design capacities of Sections 5 through 9 will be exceeded beginning about 1975.

13. The present installed capacities of the four main pumping plants will be exceeded by about year 1971 except under wet-year conditions of offshore availability.

14. Only in very wet years, when the availability of high-quality water offshore will extend into the summer months of peak demand, will the offshore availability reduce the peak flow requirements on the Contra Costa Canal system in the future.

15. The ability to deliver water into Martinez Reservoir must be substantially increased by no later than year 1970 in order to avoid restrictions on service to customers taking water supplies from the reservoir.

16. If operating criteria recently adopted by the Bureau of Reclamation limiting the permissible rate of drawdown in Martinez Reservoir are adhered to, it will be necessary to improve control of Canal waters to increase delivery capacity into Martinez Reservoir in order to avoid curtailment of service to customers receiving supplies therefrom as early as this year (1968).

17. Except for the recently completed Contra Loma Reservoir, which can provide only about three days' peak demand, the existing Contra Costa Canal system has no emergency storage to protect the District against failure of one of the main pumping plants or other accidental outage.

18. Improvements to the Contra Costa Canal system must be undertaken in the near future if the system is to continue to provide adequate and reliable water service. These improvements should include:

(a) Construction of a pipeline from the the Canal at Clyde to Martinez Reservoir;

(b) Filling the Canal downstream from the southern boundary of the United States Naval Reservation, and providing limited raw water service in Diablo Valley through a system of pumping plants and pipelines constructed in the Canal right-of-way;

(c) Enlarging the Canal flow section from the beginning of Section 5 to the Treated Water Division turnout;

(d) Augmenting the capacity of the four main pumping plants on the Canal by addition of a sixth pump unit at each plant.

19. The proposed Kellogg Unit would provide a substantial degree of reliability to the water supply system serving the District through the ability to deliver water supplies by gravity throughout the service area in case of a power outage or mechanical failure of a main pumping plant.

20. The proposed Kellogg Unit must be in operation no later than 1976 in order to avoid the necessity of enlarging Sections 1 through 4 of the Contra Costa Canal, reconstructing the four main pumping plants, and installing new pump units having increased capacity. The Unit should be in operation much sooner than that in order to minimize potential hazards to the District due to: (1) the necessity to operate the Canal system beyond its design capacity; (2) the lack of adequate emergency storage in the Canal system; and (3) the lack of a sure supply of high-quality water.

21. Some improvement in the quality of water supplies delivered through the Canal system during the winter months could be attained through construction of barriers which would permit the supplies to be drawn from Fox Slough rather than from Rock Slough at certain times.

22. The United States Bureau of Reclamation is undertaking a program of short-term improvements to the Contra Costa Canal system. This program is not compatible in all respects with the over-all improvement plan proposed in this Report.

23. The present method of operation of the Contra Costa Canal system is not working well, due principally to: (1) inability to react rapidly to changes in delivery rate to major customers; (2) widely fluctuating rates of withdrawal by some major customers; and (3) flow surges in the Canal caused by non-uniform pumping.

24. The Contra Costa Canal system suffers from a number of inadequacies from the standpoint of safety, right-of-way maintenance, and cross-drainage. The existing metering system is also deficient in certain respects.

25. If the District had operated the Contra Costa Canal system in the period 1958 through 1966, the costs to the District for Canal O & M and for Pumping Plant O & M would have averaged 16% and 22% greater, respectively, than the actual costs reported by the Bureau for this period. Total combined District costs would have been 18% greater than actual Bureau costs.

26. Service to the District's customers would be greatly improved and duplication of effort between the District and the Bureau would be eliminated if the District were to take over responsibility for operation and maintenance of the Contra Costa Canal system. These factors would justify a moderate increase in the cost of operating the system.

27. Implementation of the improvement program proposed in this Report for the Canal system would result in an over-all reduction in system operation and maintenance costs. However, if the District were to take over the responsibility for O & M, some additional costs would be incurred due to upgrading of certain aspects of the maintenance program.

28. A supervisory control system, coupled with improvements to the District's present metering system, could greatly improve the operation of the Contra Costa Canal system, and would probably reduce operating costs for the system by a substantial amount.

29. The costs of improvements to the Canal system proposed in this Report through year 1980, including those portions of the Bureau program which are compatible with the over-all improvement plan, are estimated to total some $12.7 million at 1967 price levels, assuming the District constructs all improvements not included in the present Bureau program. This total includes allowances for engineering costs and contingencies.

30. Assuming financing and construction by the District, a water charge of about $26 per acre foot on the first 86,000 acre feet received from the Federal Central Valley Project would probably be required to repay all costs of the improvements to the Contra Costa Canal system proposed in this Report, together with District O & M expenses of the improved system, presently outstanding costs of the Contra Costa Canal and Contra Loma Reservoir, and a $2 per acre foot charge towards repayment of the costs of existing storage facilities in the CVP. These costs would all be repaid within 50 years of the time incurred, with interest at 3¼% annually. The water charge would be about $25 per acre foot in the case of Bureau financing and construction.

31. The present Contra Costa Canal system is the property of the United States. As such, the consent of the Federal Government would have to be obtained before the District could finance and construct any of the improvements proposed in this Report.

32. A water charge of about $24 per acre foot on deliveries from the Federal Central Valley Project in excess of 86,000 acre feet annually would probably be sufficient to repay all costs of the proposed Kellogg Unit reasonably allocable to the District, including operation and maintenance costs and a $2 per acre foot storage charge. These costs would be repaid within 50 years, with annual interest at the rate of 3¼%, even assuming the minimum annual water deliveries within the present District service area forecast in this Report. If deliveries through Kellogg corresponding to median-year conditions of offshore water supply are assumed, a water charge of $20 per acre foot would probably be sufficient; the corresponding figure would be $17 per acre foot under dry-year conditions of offshore supply.

33. If the Bureau of Reclamation were to undertake both the Canal system improvements and the proposed Kellogg Unit, a water charge of from $20 to $25 per acre foot on all supplies taken from the CVP would probably be adequate to repay both, together with presently outstanding capital costs, O & M costs, and the $2 per acre foot storage charge. Under median-year conditions of offshore water supply, the required repayment charge would be $22 per acre foot. An additional storage charge of unknown magnitude would have to be levied on deliveries in excess of 195,000 acre feet, in order to repay costs of additional storage in the Central Valley Project allocable to the District.

34. There will be a need for treated water service from surface supplies in the Brentwood, Byron, and Islands sub-areas in the foreseeable future. These areas are now outside the boundaries of the District.

35. For the Brentwood and Islands sub-areas, the source of surface supplies will probably be the proposed Kellogg Reservoir. For the Byron sub-area, it may be better to take supplies directly from the Clifton Court Forebay, or from Herdlyn Reservoir.

XV. RECOMMENDATIONS

1. The District should expend every effort to see that the feasibility report supporting the proposed Kellogg Unit is completed by the United States Bureau of Reclamation and submitted to Congress at the earliest possible date.

2. If the terms and conditions as to prospective water charges to the District presented in the feasibility report are reasonable, the District should consult with the Bureau of the Budget and the appropriate Congressional committees to ascertain the prospects of authorization and funding of the Kellogg Unit in time for it to be operational no later than 1976.

3. The program for improvements to the Contra Costa Canal system proposed in this Report, shown schematically on Plate 17, should be implemented in accordance with the development schedule set forth in Table 34.

4. The District should meet immediately with representatives of Region 2, United States Bureau of Reclamation, in an effort to reach agreement on the program for Canal system improvements. Following this, meetings should be held in Washington with representatives of the Bureau of Reclamation, the Bureau of the Budget, and the appropriate committees of Congress, to ascertain the prospects of gaining authorization and funding as necessary to ensure that an acceptable schedule of development for the improvements can be realized.

5. If it becomes apparent that there is no reasonable probability that the Bureau can construct the improvements to the Canal within the required time schedule, the District should then take steps to implement the improvement program itself, either in its entirety or to the extent that it connot be accomplished by the Bureau within the time limits. In this case, Congressional approval should be sought for the District to take over ownership of the Canal system upon completion of payout.

6. The District should take over operation and maintenance of the entire Contra Costa Canal system, but not until the proposed Kellogg Unit or alternate thereto is constructed and in operation. District responsibility for O & M should encompass all facilities downstream from Kellogg.

7. The District should urge the Bureau of Reclamation to take all necessary steps to ensure that Martinez Reservoir and the Canal system can be so operated as to meet the demands of customers served from the Reservoir during the period prior to completion of the Clyde-Martinez pipeline.

8. The District should request the Bureau of Reclamation to increase the contractual limit on water supplies to be made available to it from the existing Contra Costa Canal Unit of the Federal Central Valley Project from the present 86,000 acre feet to at least 160,000 acre feet annually. This will permit continued service through the improved Contra Costa Canal system during the period prior to completion of the proposed Kellogg Unit or alternate thereto.

9. The District should be prepared to expand its service area to encompass the Brentwood, Byron, and Islands sub-areas, and to form improvement districts for service of treated water for municipal and industrial use within those sub-areas when and if desired by their residents.

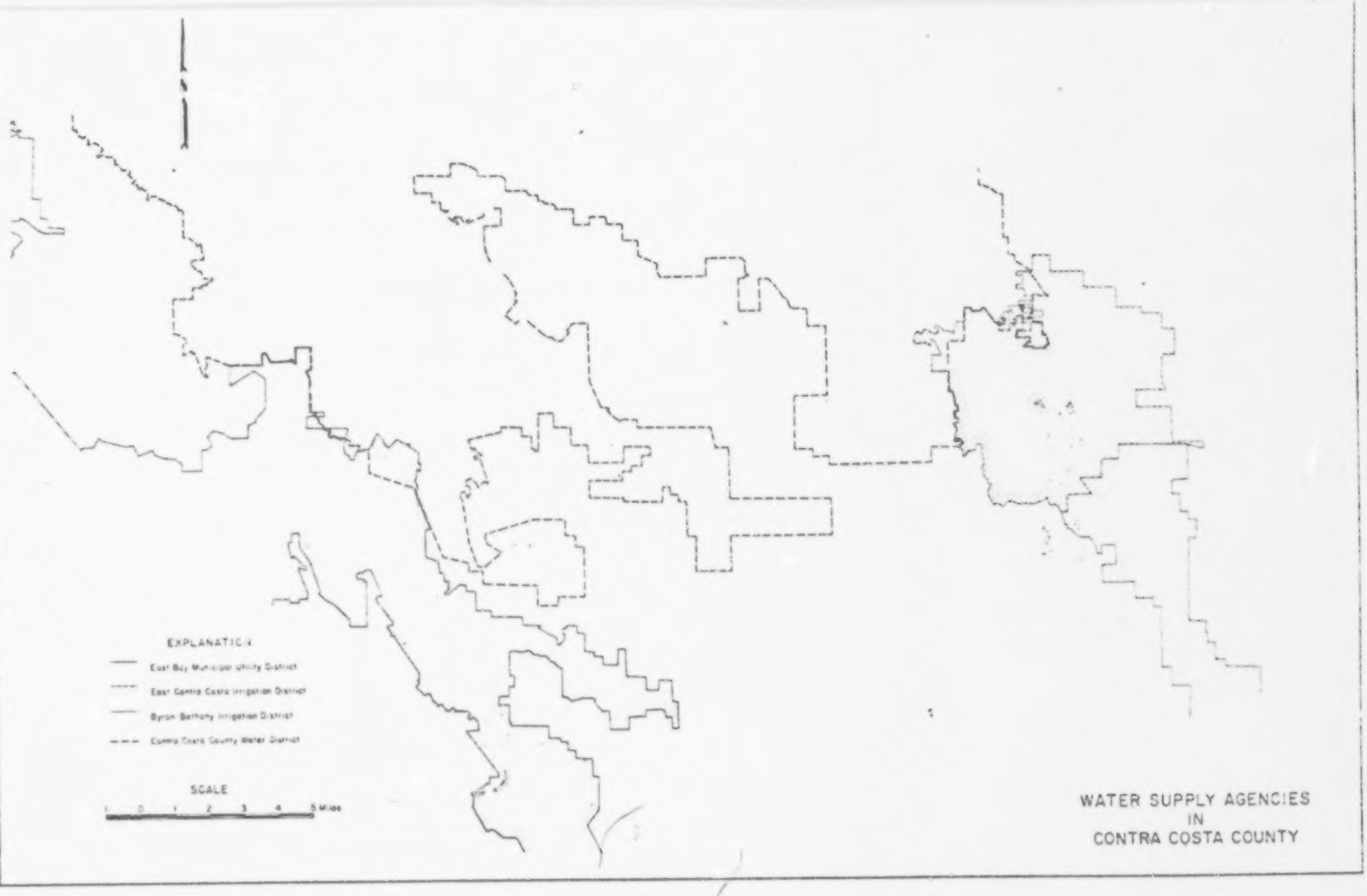
10. The District should in the immediate future undertake the following studies:

    (a) an investigation of the feasibility of reclamation and use of the effluent from the Central Contra Costa Sanitary District sewage treatment plant;

    (b) an investigation of incorporation of a supervisory control system into the Contra Costa Canal system, and of the facilities needed for improved metering of water use by its major customers; and

    (c) an investigation of the requirements for the water quality testing and control program.

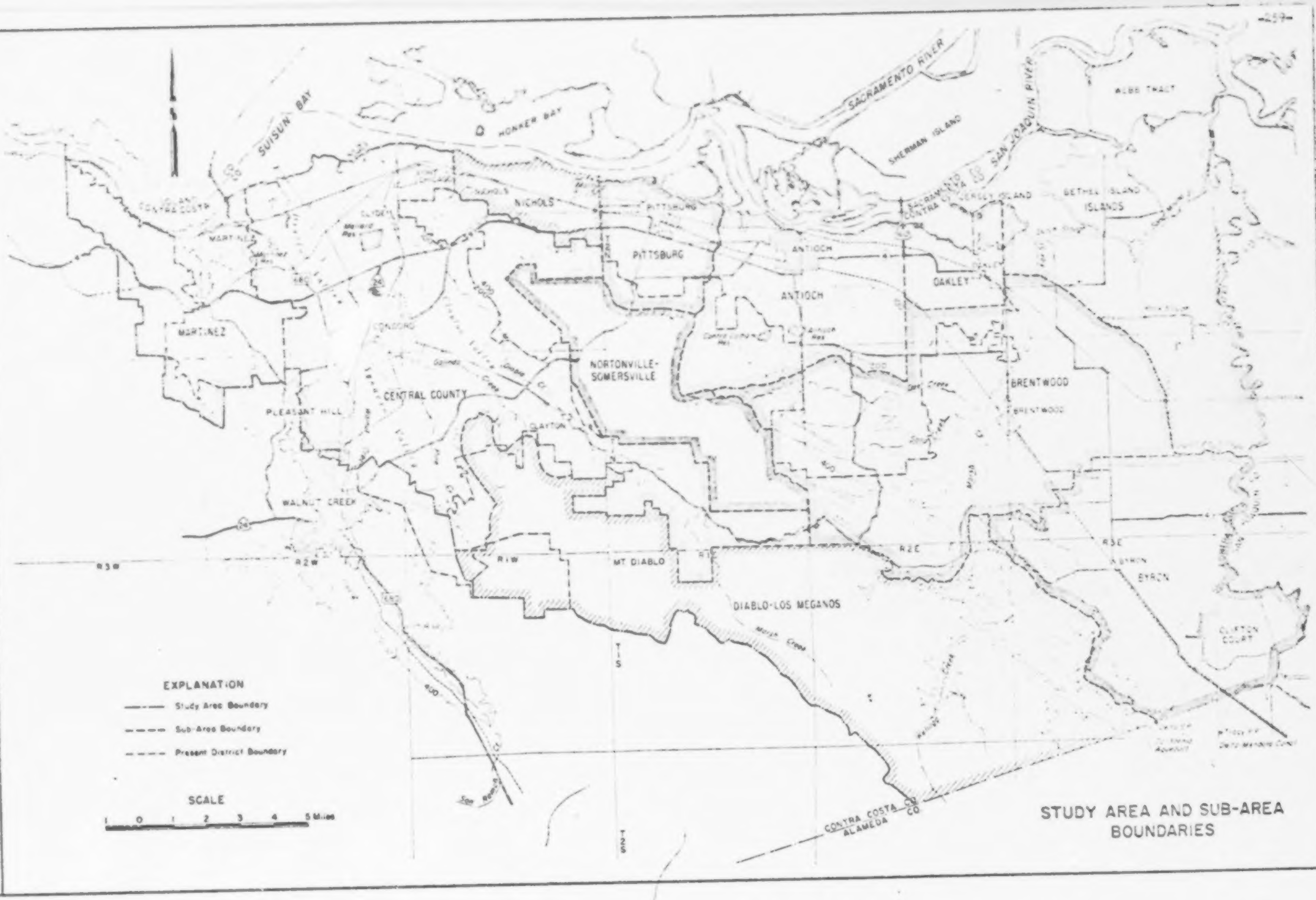
PLATES


EXPLANATION
East Bay Municipal Utility District
East Contra Costa Irrigation District
Byron-Bethany Irrigation District
Contra Costa County Water District
SCALE
1 0 1 2 3 4 5 Miles

WATER SUPPLY AGENCIES
IN
CONTRA COSTA COUNTY

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

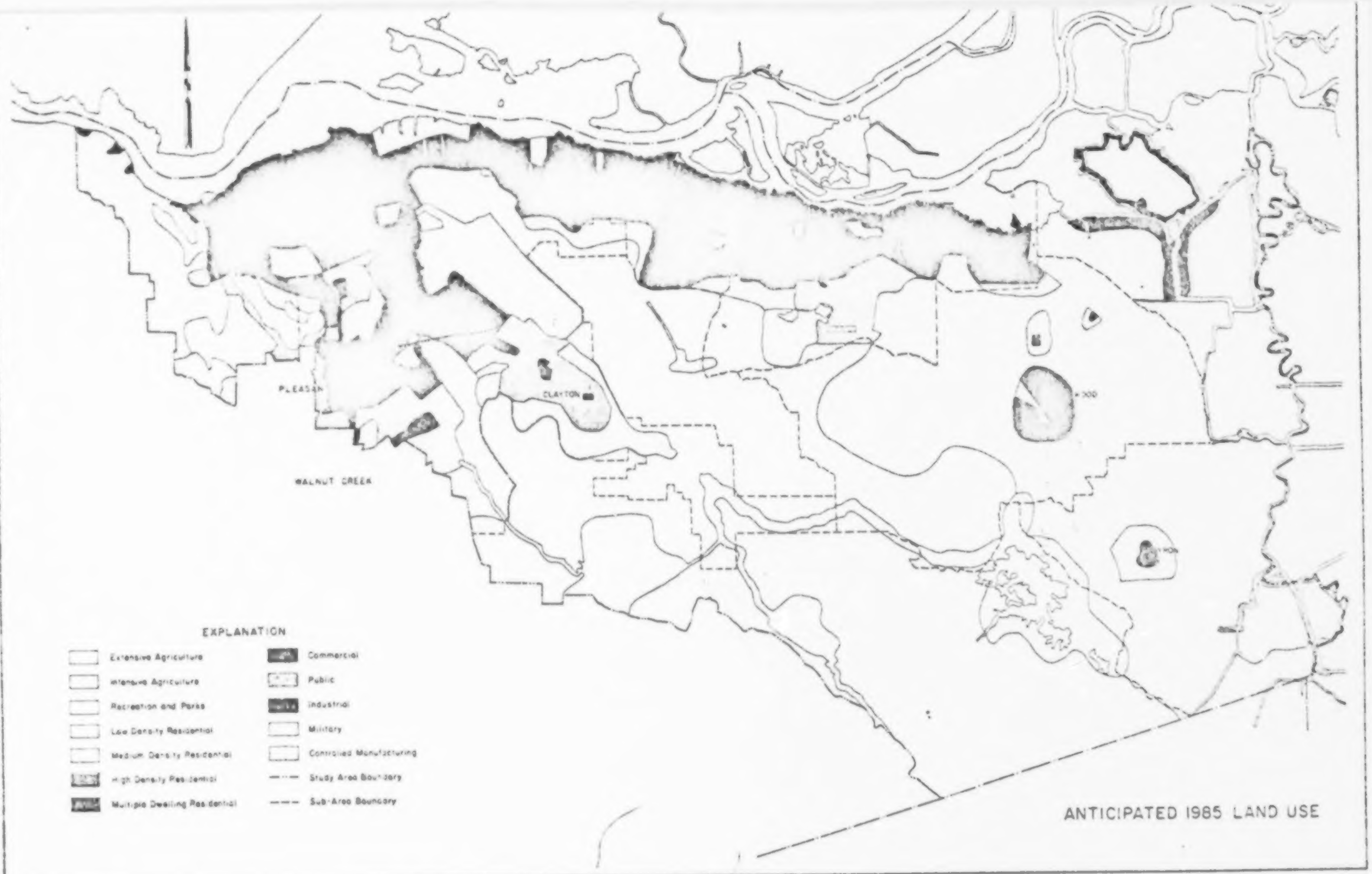
Drawn M.R. Hahn
Date January 5, 1966


SUISUN BAY
HONKER BAY
SACRAMENTO RIVER
SAN JOAQUIN RIVER
SHERMAN ISLAND
WEBB TRACT
BETHEL ISLAND
ISLANDS
JERSEY ISLAND
CONTRA COSTA
MARTINEZ
NICHOLS
PITTSBURG
ANTIOCH
OAKLEY
BRENTWOOD
CONCORD
CENTRAL COUNTY
NORTONVILLE-SOMERSVILLE
PLEASANT HILL
CLAYTON
WALNUT CREEK
MT DIABLO
DIABLO-LOS MEGANOS
BYRON
CLIFTON COURT
R3W
R2W
R1W
R1E
R2E
R3E
T1S
T2S
CONTRA COSTA CO
ALAMEDA CO
EXPLANATION
Study Area Boundary
Sub-Area Boundary
Present District Boundary
SCALE
1 0 1 2 3 4 5 Miles

STUDY AREA AND SUB-AREA BOUNDARIES

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn M.K. Hohn
Date January 5, 1968

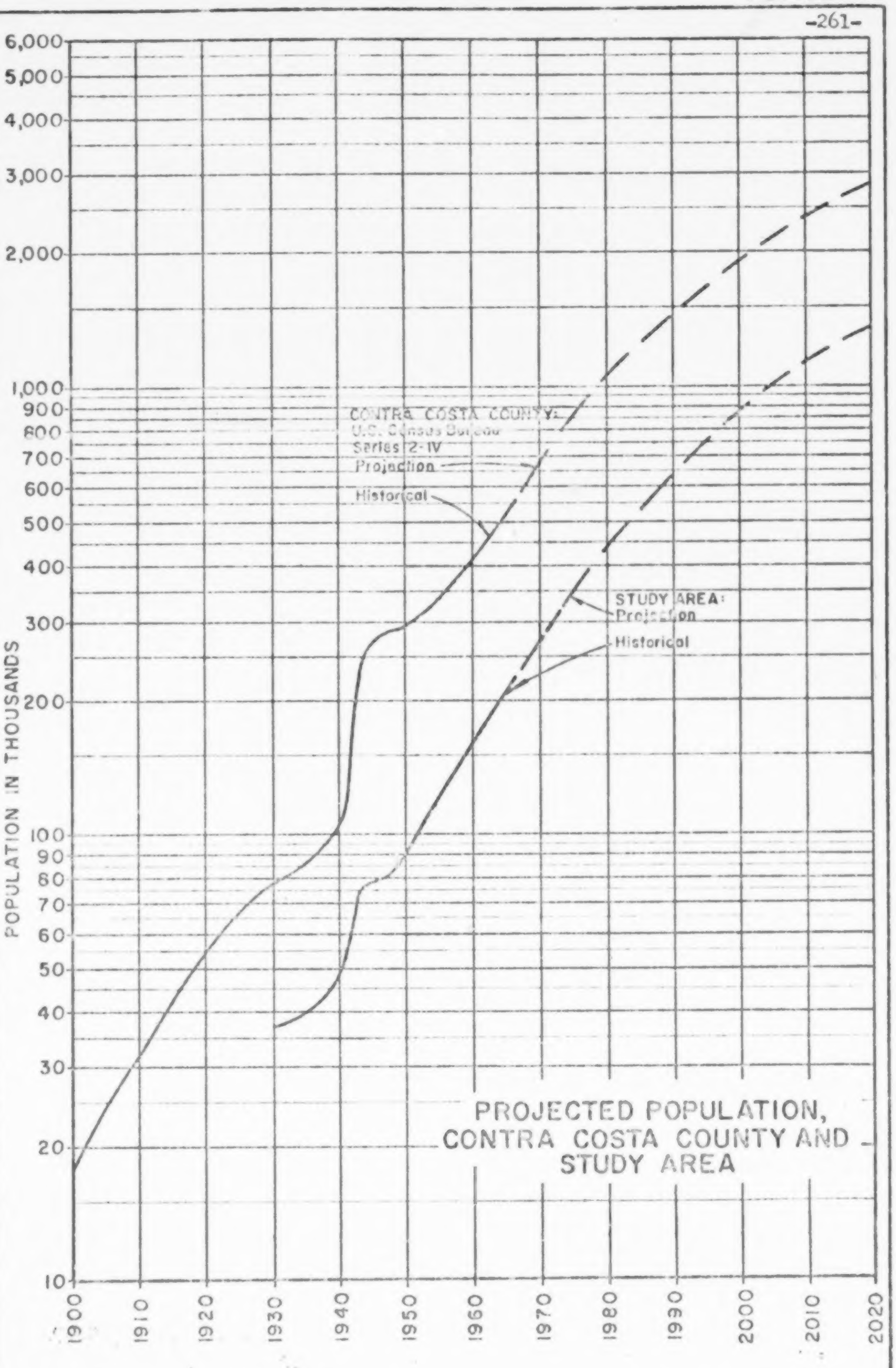

PLEASAN
CLAYTON
WALNUT CREEK
EXPLANATION
Extensive Agriculture
Intensive Agriculture
Recreation and Parks
Low Density Residential
Medium Density Residential
High Density Residential
Multiple Dwelling Residential
Commercial
Public
Industrial
Military
Controlled Manufacturing
Study Area Boundary
Sub-Area Boundary

ANTICIPATED 1985 LAND USE

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn M K Hahn
Date January 5, 1968

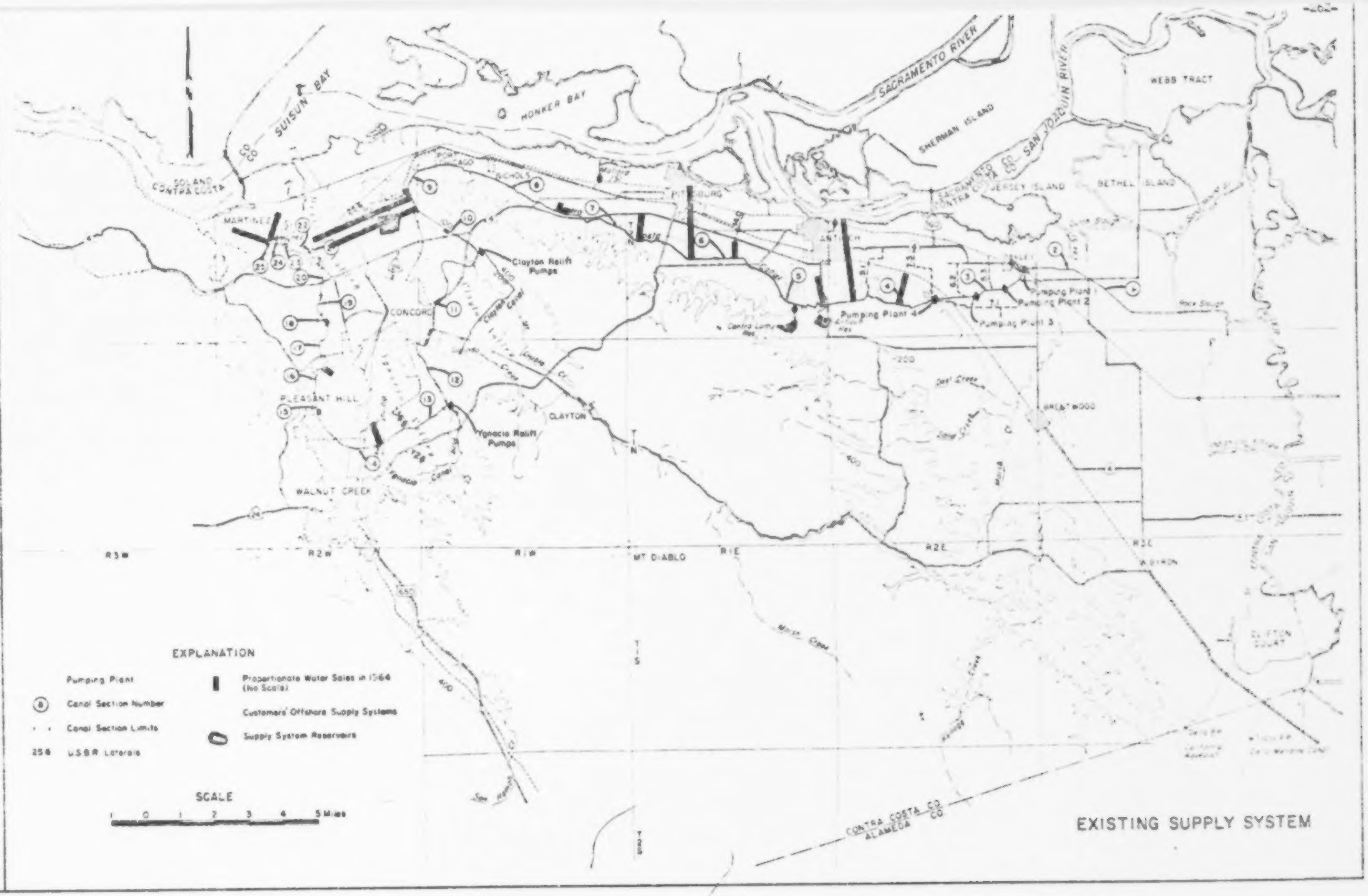
PLATE 4



PROJECTED POPULATION, CONTRA COSTA COUNTY AND STUDY AREA

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles

Drawn: J.L. Ludlow
Date: January 5, 1968


SUISUN BAY
HONKER BAY
SACRAMENTO RIVER
SAN JOAQUIN RIVER
SHERMAN ISLAND
JERSEY ISLAND
BETHEL ISLAND
WEBB TRACT
SOLANO
CONTRA COSTA
MARTINEZ
PITTSBURG
ANTIOCH
CONCORD
PLEASANT HILL
WALNUT CREEK
CLAYTON
BRENTWOOD
NICHOLS
Clayton Relift Pumps
Ygnacio Relift Pumps
Ygnacio Canal
Clayton Canal
Contra Loma Res.
Pumping Plant 1
Pumping Plant 2
Pumping Plant 3
Pumping Plant 4
Rock Slough
Deer Creek
Marsh Creek
CLIFTON COURT
R3W
R2W
R1W
MT DIABLO
R1E
R2E
R3E
T1N
T1S
BYRON
CONTRA COSTA CO.
ALAMEDA CO.
EXPLANATION
Pumping Plant
Canal Section Number
Canal Section Limits
258 USBR Laterals
Proportionate Water Sales in 1964 (No Scale)
Customers' Offshore Supply Systems
Supply System Reservoirs
SCALE
1 0 1 2 3 4 5 Miles

EXISTING SUPPLY SYSTEM

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn M.K. Hahn
Date January 5, 1968

PLATE 6

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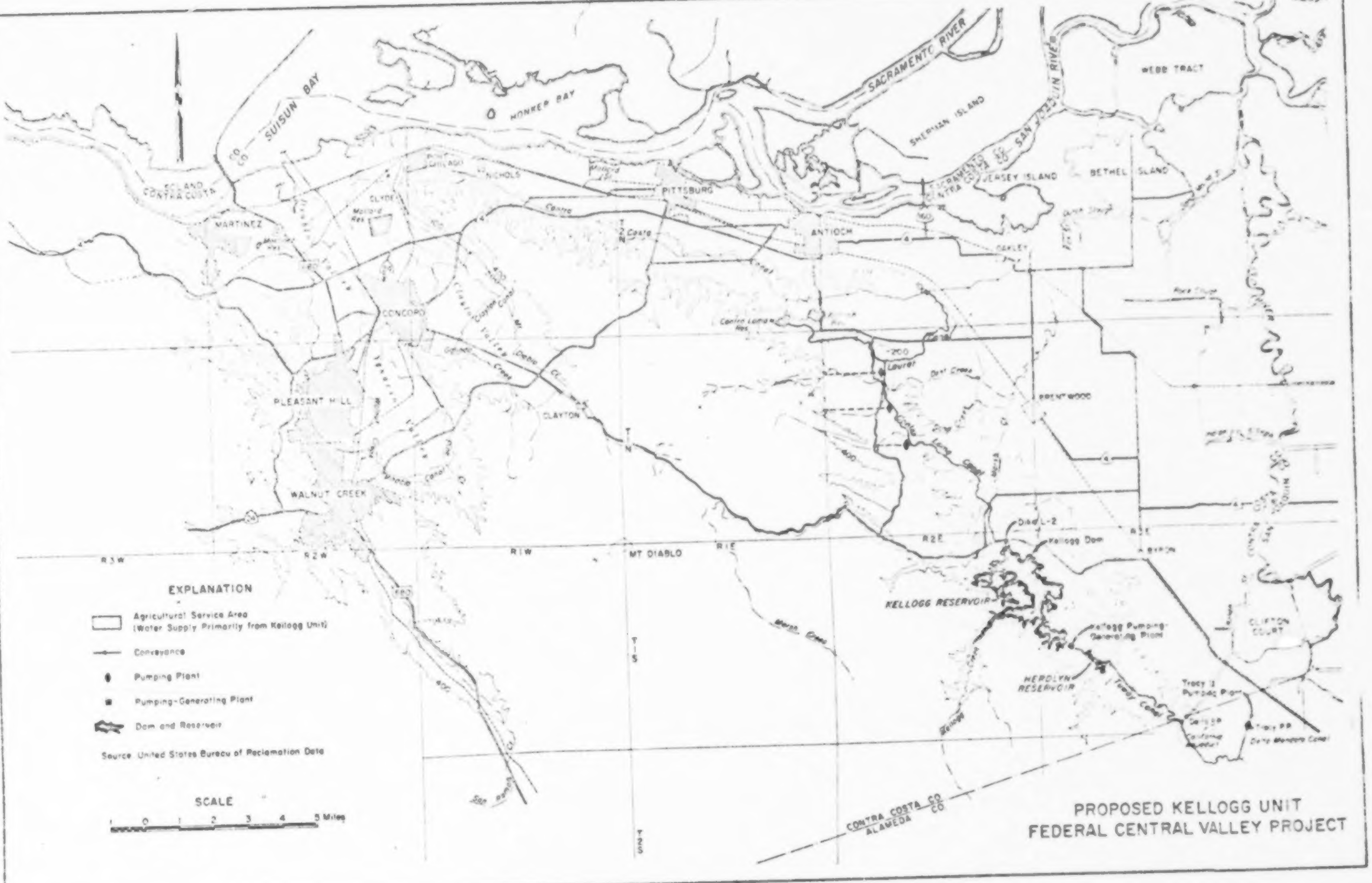

SUISUN BAY
HONKER BAY
SACRAMENTO RIVER
SAN JOAQUIN RIVER
WEBB TRACT
SHERMAN ISLAND
JERSEY ISLAND
BETHEL ISLAND
SOLANO
CONTRA COSTA
SACRAMENTO CO
CONTRA COSTA CO
MARTINEZ
CLYDE
NICHOLS
PITTSBURG
ANTIOCH
OAKLEY
CONCORD
PLEASANT HILL
WALNUT CREEK
CLAYTON
BRENTWOOD
BYRON
CLIFTON COURT
MT DIABLO
Contra Costa Canal
Contra Loma Res
Marsh Creek
Kellogg Dam
KELLOGG RESERVOIR
Kellogg Pumping-Generating Plant
HEROLYN RESERVOIR
Tracy Canal
Tracy 3 Pumping Plant
Tracy PP
Delta Mendota Canal
California Aqueduct
CONTRA COSTA CO
ALAMEDA CO
R 3 W
R 2 W
R 1 W
R 1 E
R 2 E
R 3 E
T 2 N
T 1 N
T 1 S
T 2 S
EXPLANATION
Agricultural Service Area (Water Supply Primarily from Kellogg Unit)
Conveyance
Pumping Plant
Pumping-Generating Plant
Dam and Reservoir
Source: United States Bureau of Reclamation Data
SCALE
1 0 1 2 3 4 5 Miles

PROPOSED KELLOGG UNIT
FEDERAL CENTRAL VALLEY PROJECT

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles

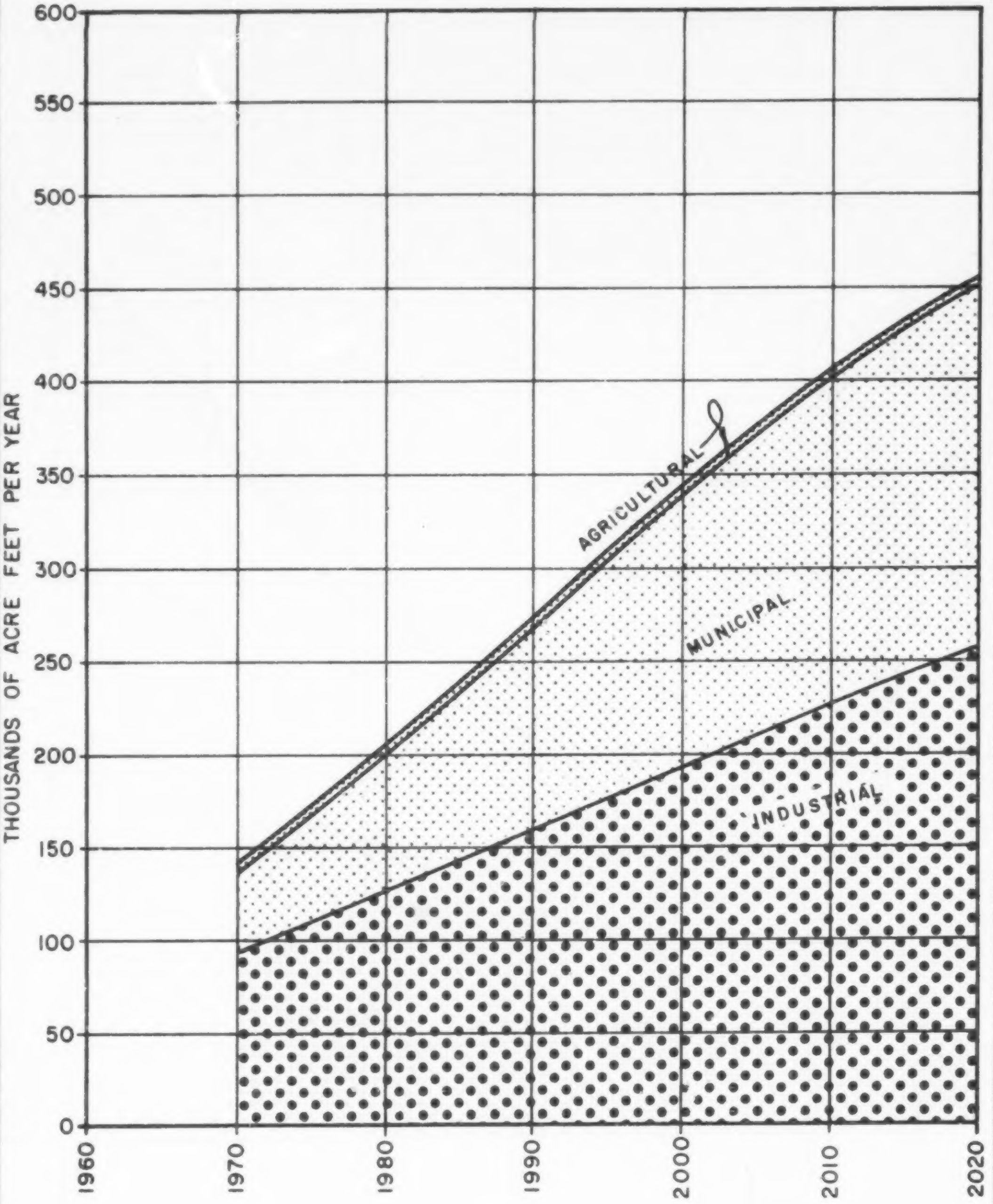
Drawn: M.K. Hahn
Date: January 5, 1968

- 263.

PLATE 7

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles

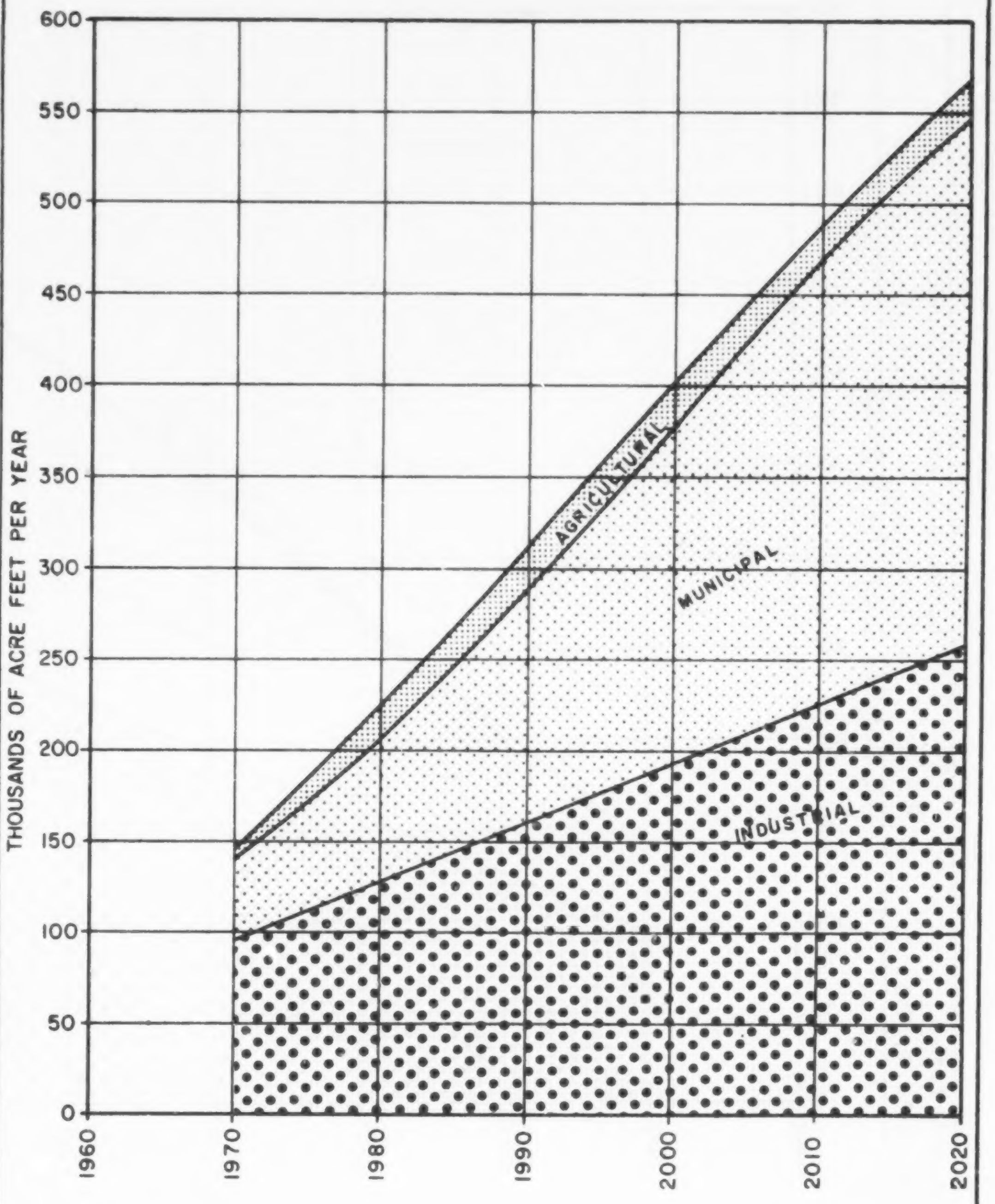
Drawn: J.L. Ludlow
Date: January 5, 1968



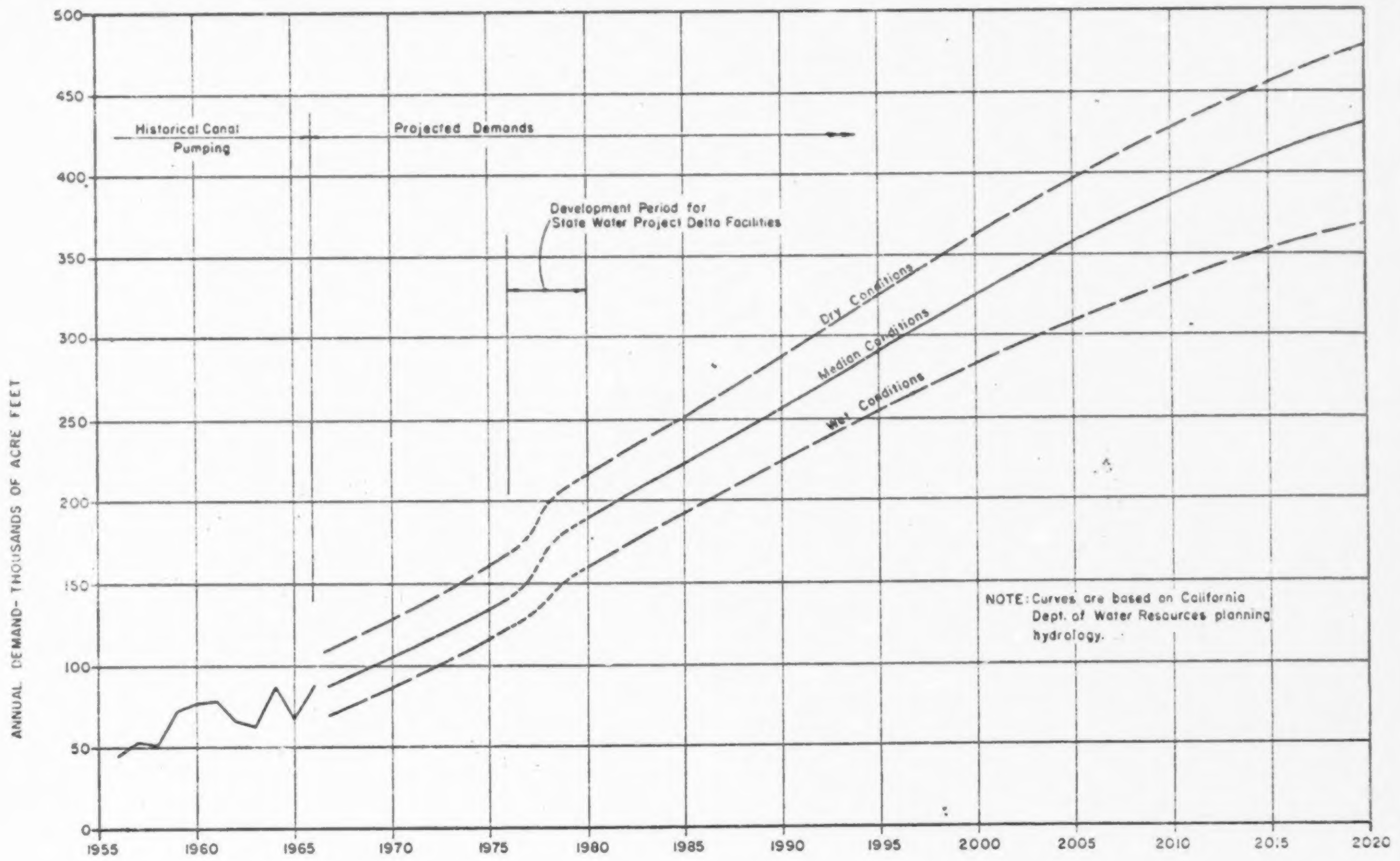
REQUIREMENTS FOR
HIGH-QUALITY WATER,
PRESENT DISTRICT SERVICE AREA

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles

Drawn: J.L.Ludlow
Date: January 5, 1968



REQUIREMENTS FOR
HIGH-QUALITY WATER,
TOTAL STUDY AREA

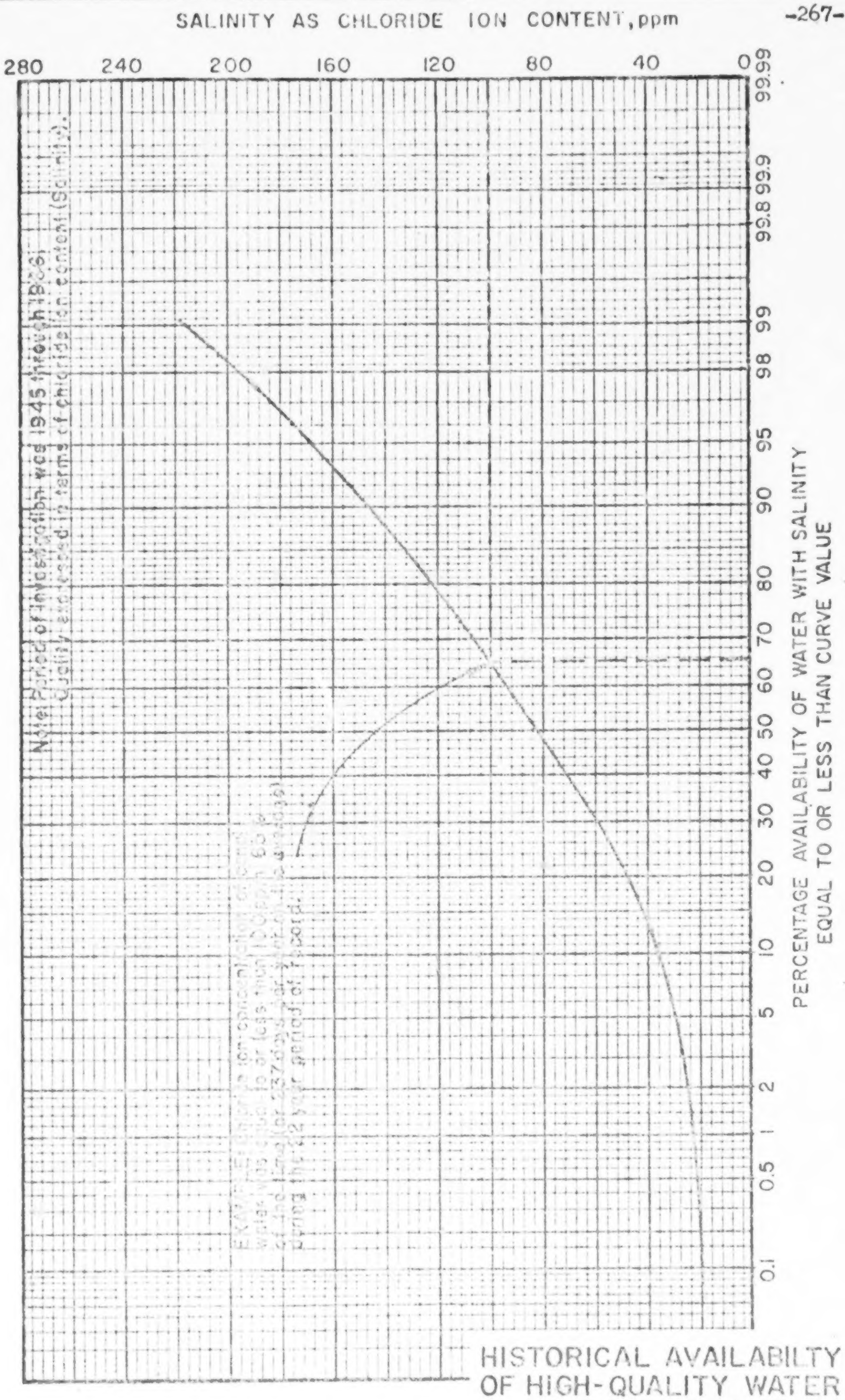


NOTE: Curves are based on California Dept. of Water Resources planning hydrology.

DEMAND ON
OVERLAND SUPPLY SYSTEM
WITHIN PRESENT DISTRICT

Drawn J.L. Ludlow
Date January 5, 1968

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles



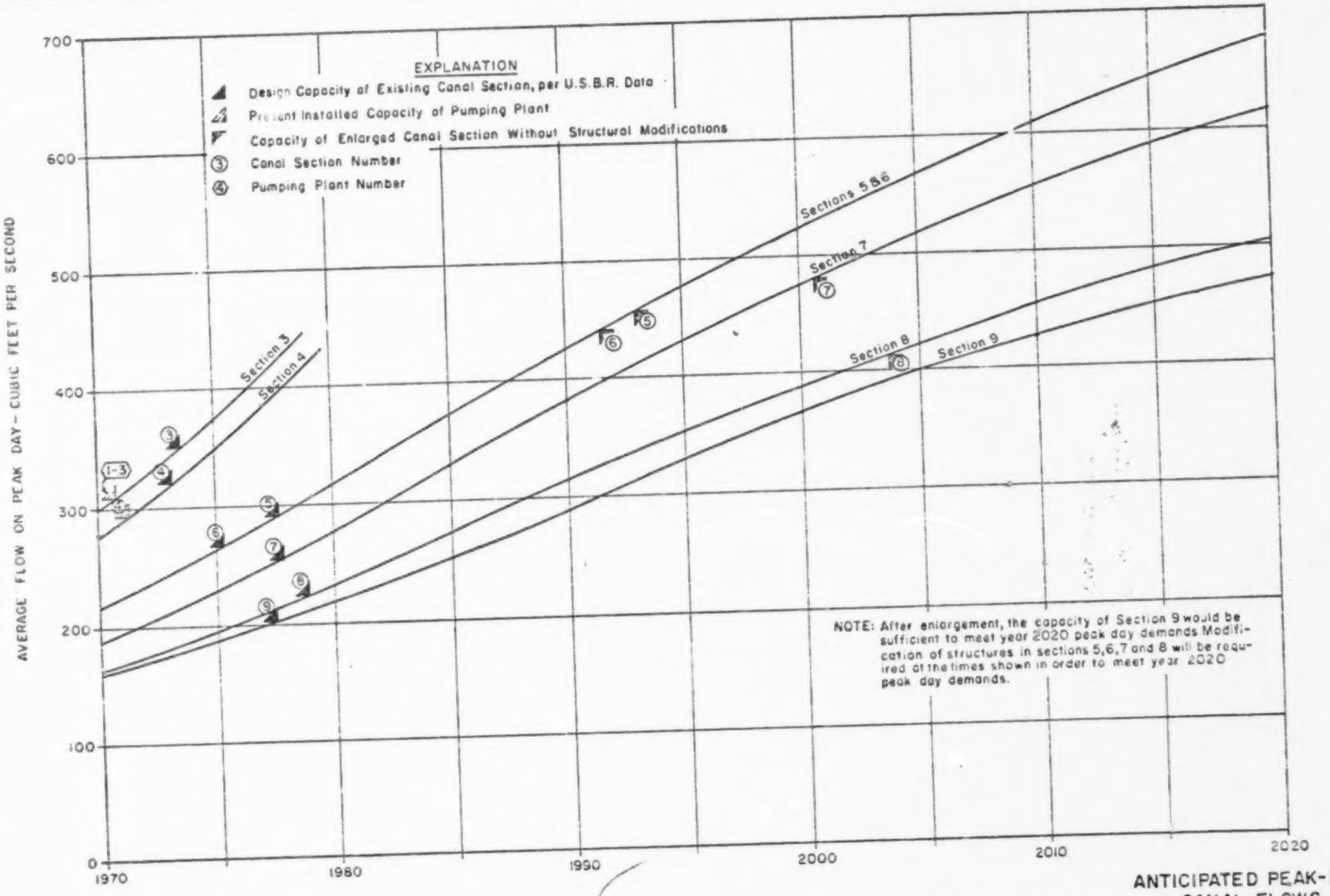
Note: Period of investigation was 1945 through 1966. Quality expressed in terms of chloride ion content (Salinity).

EXAMPLE: Chloride ion concentration of water was equal to or less than 100 ppm 65 % of the time (or 237 days per year on the average) during the 22 year period of record.

HISTORICAL AVAILABILTY OF HIGH-QUALITY WATER AT ROCK SLOUGH

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles

Drawn: J.L.Ludlow
Date: January 5, 1968

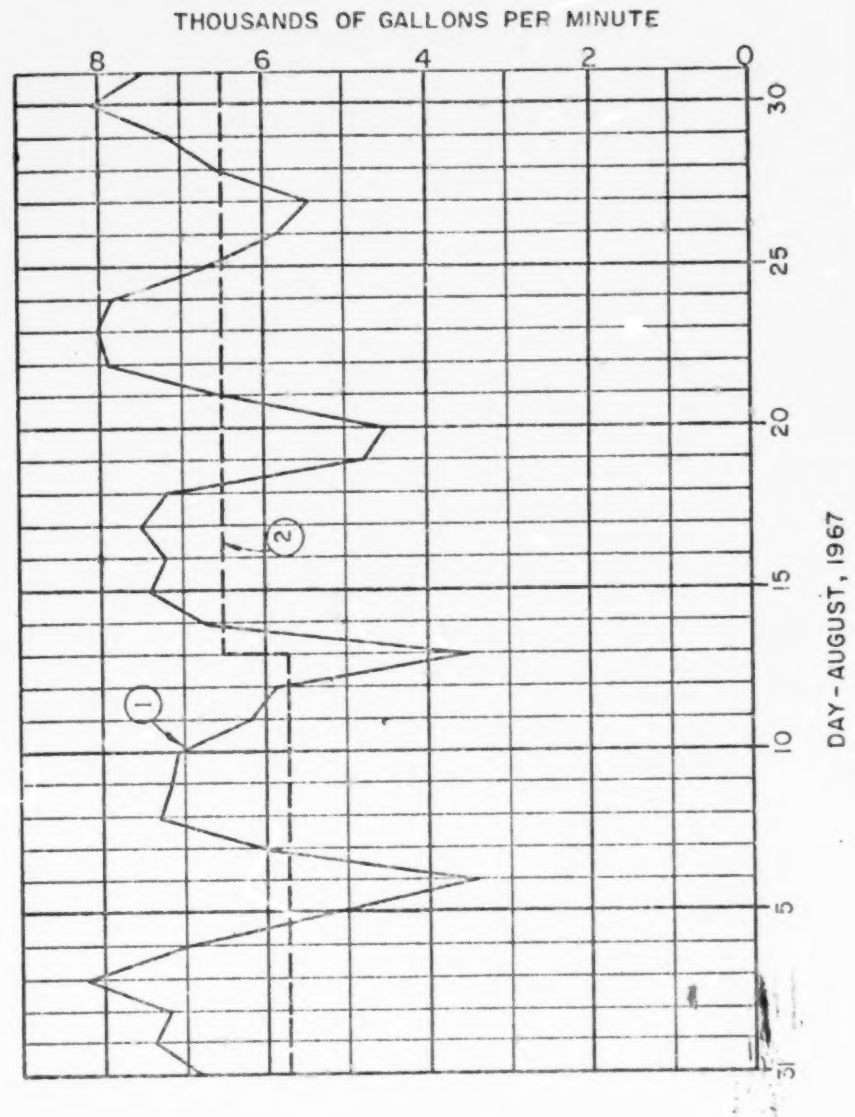


NOTE: After enlargement, the capacity of Section 9 would be sufficient to meet year 2020 peak day demands. Modification of structures in sections 5,6,7 and 8 will be required at the times shown in order to meet year 2020 peak day demands.

ANTICIPATED PEAK-DAY CANAL FLOWS

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn: J.L. Ludlow
Date: January 5, 1968



① Average delivery flow rate to one of District's major industrial customers for August, 1967.

② Customer's water order.

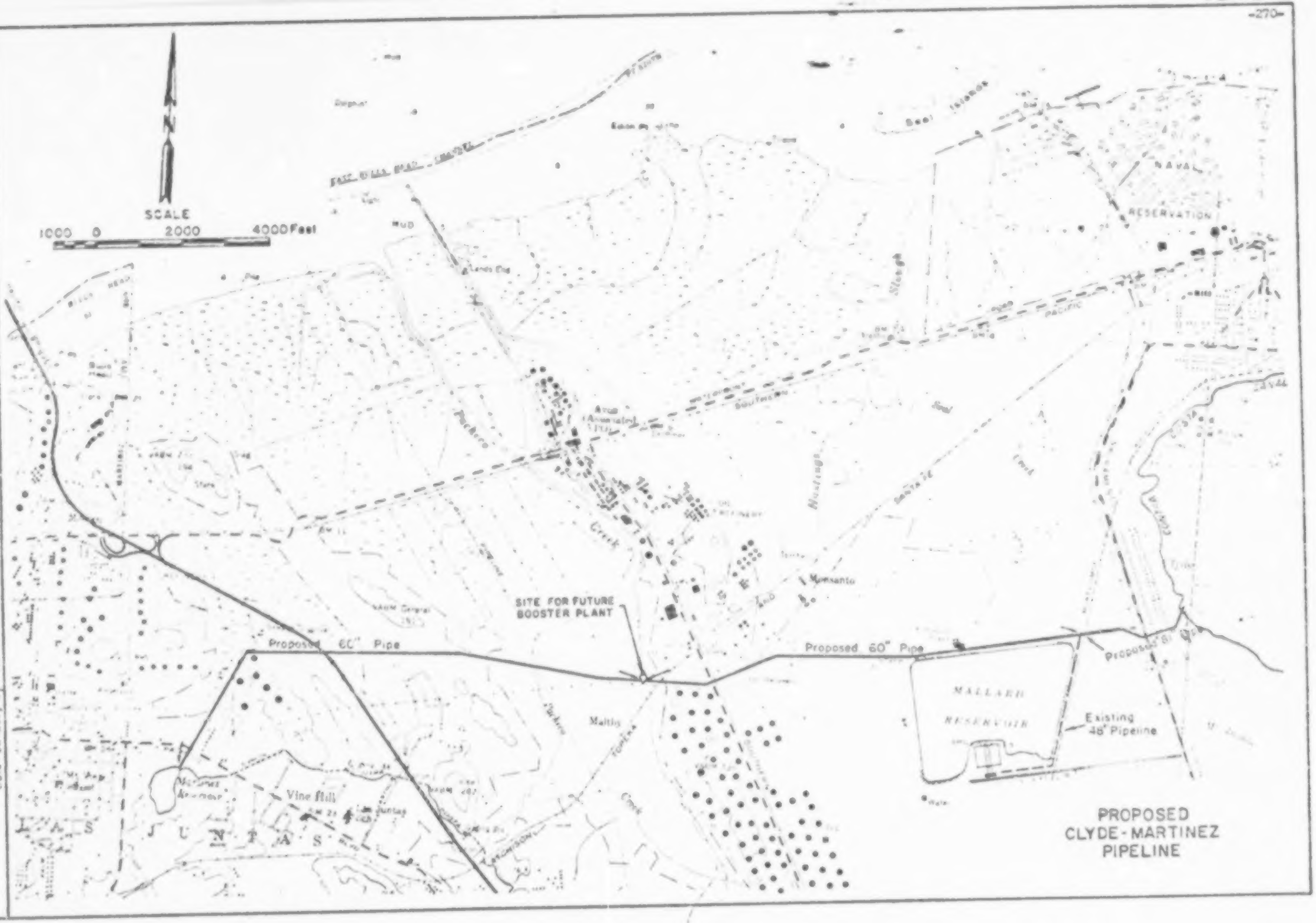
LEEDS, HILL AND JEWETT, INC.

San Francisco Los Angeles

Drawn: J.L. Ludlow

Date: January 5, 1968

EXAMPLE OF WATER ORDERS AND DELIVERIES


SCALE
1000 0 2000 4000 Feet
NAVAL RESERVATION
Seal Islands
Slough
PACIFIC
SOUTHERN
Pacheco
Creek
Hastings
Monsanto
SITE FOR FUTURE BOOSTER PLANT
Proposed 60" Pipe
Proposed 60" Pipe
Proposed 81" Pipe
MALLARD RESERVOIR
Existing 48" Pipeline
Vine Hill
Martinez Reservoir
J U N T A S
Mud
EAST BULL HEAD

PROPOSED CLYDE-MARTINEZ PIPELINE

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn J.L. Ludlow
Date January 5, 1968

PLATE
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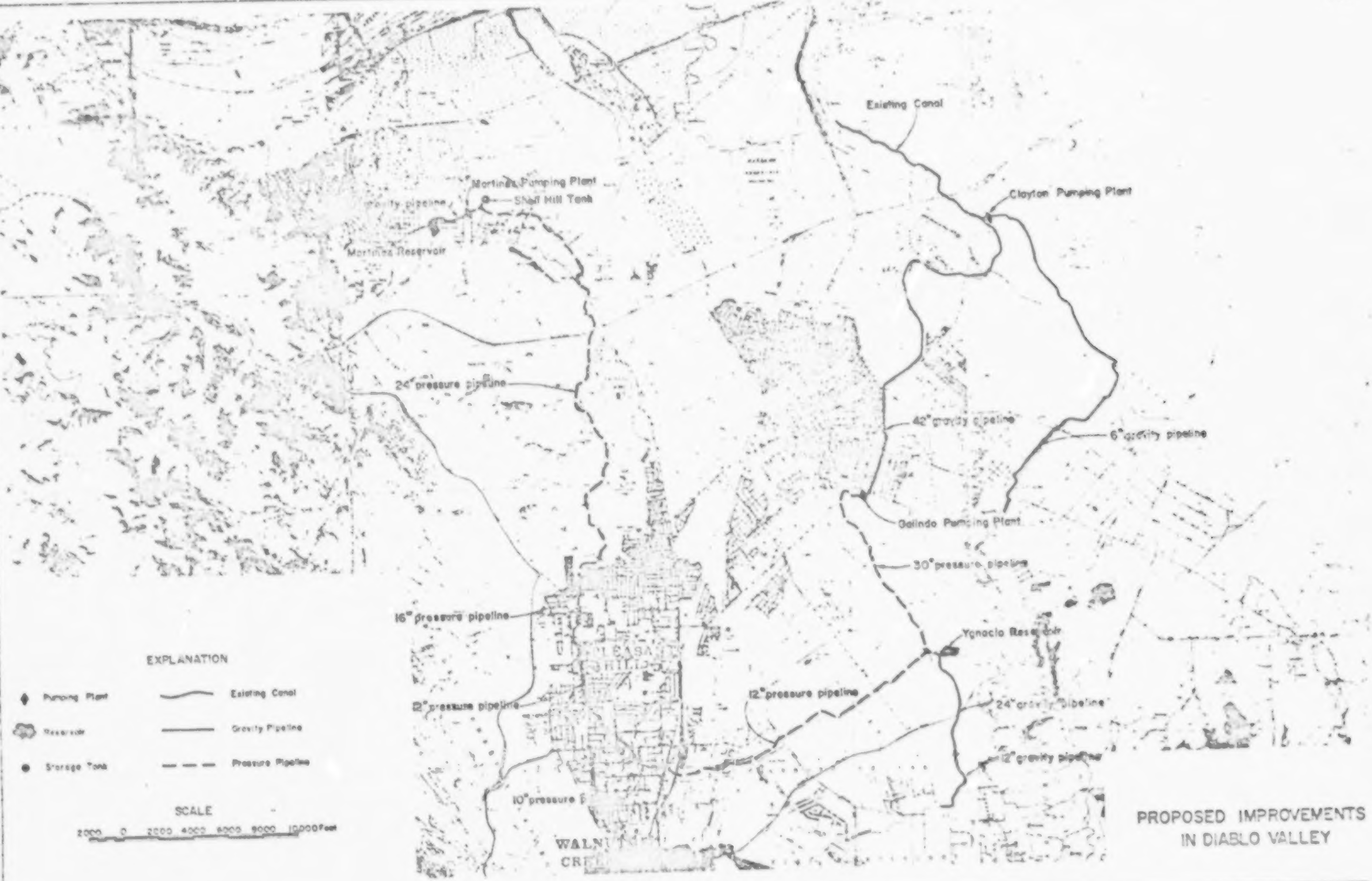
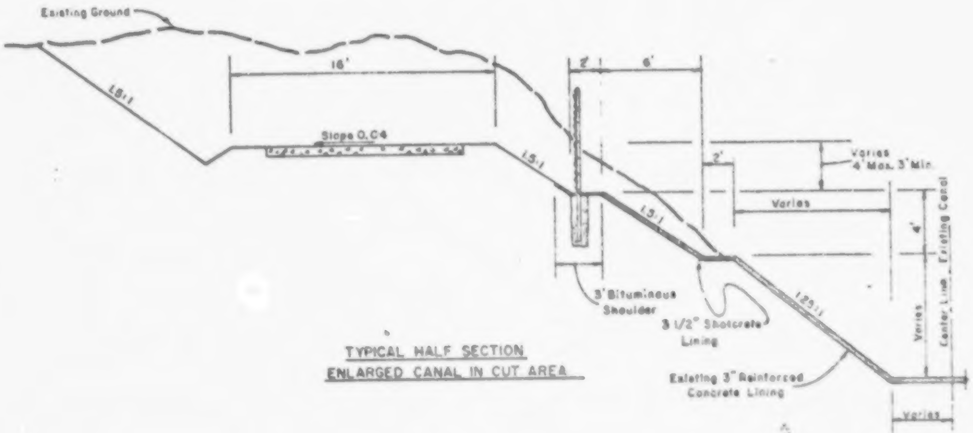
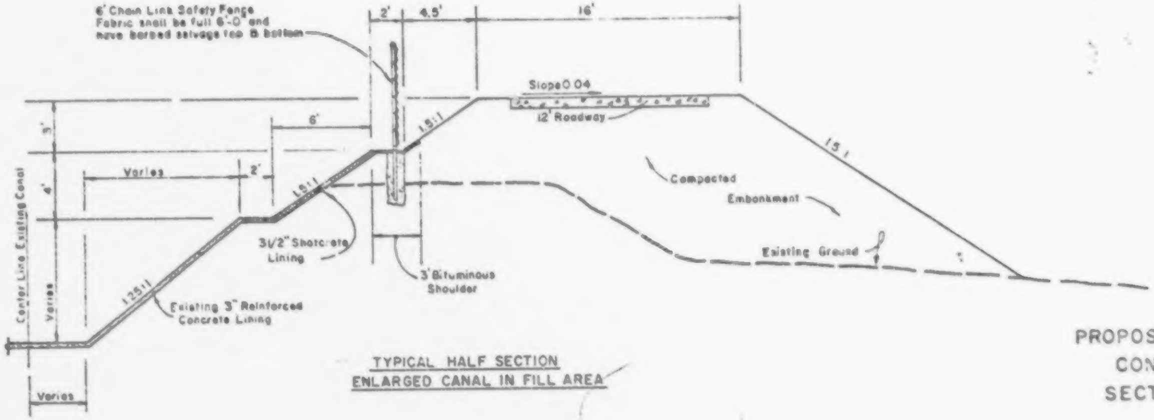

Existing Canal
Clayton Pumping Plant
Martinez Pumping Plant
Shell Hill Tank
gravity pipeline
Martinez Reservoir
24" pressure pipeline
42" gravity pipeline
6" gravity pipeline
Galindo Pumping Plant
30" pressure pipeline
16" pressure pipeline
Ygnacio Reservoir
12" pressure pipeline
12" pressure pipeline
24" gravity pipeline
12" gravity pipeline
10" pressure
PLEASANT HILLS
WALNUT CREEK
EXPLANATION
Pumping Plant
Reservoir
Storage Tank
Existing Canal
Gravity Pipeline
Pressure Pipeline
SCALE
2000 0 2000 4000 6000 8000 10000 Feet

PROPOSED IMPROVEMENTS
IN DIABLO VALLEY

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles
Drawn J.L.Ludlow
Date January 5, 1969


Existing Ground
16'
L8:1
Slope 0.04
1.5:1
2'
6'
1.5:1
2'
Varies
4' Max. 3' Min.
Varies
4'
Varies
1.25:1
Center Line Existing Canal
3' Bituminous Shoulder
3 1/2" Shotcrete Lining
Existing 3" Reinforced Concrete Lining
Varies

TYPICAL HALF SECTION
ENLARGED CANAL IN CUT AREA

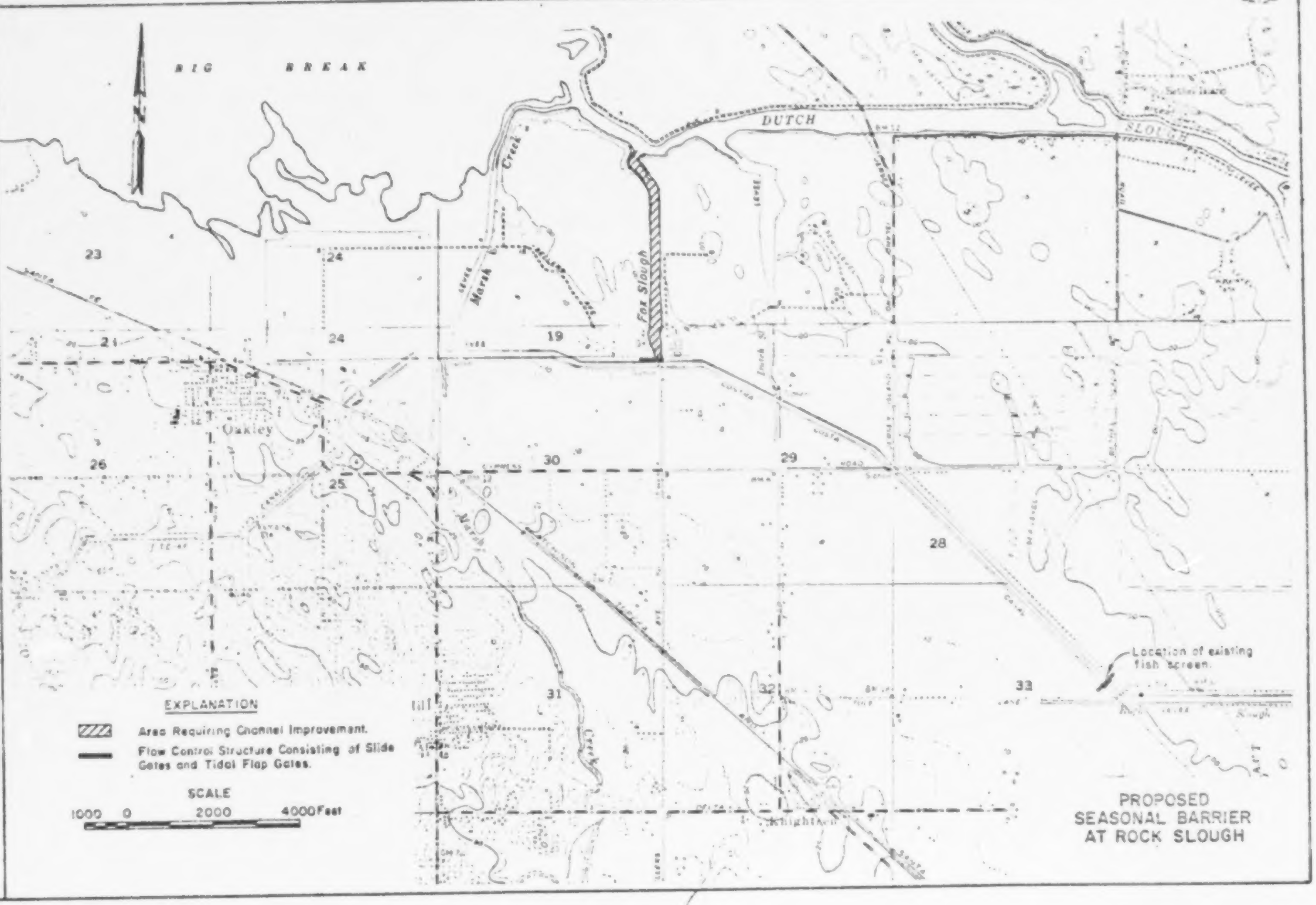

6' Chain Link Safety Fence
Fabric shall be full 6'-0" and have barbed selvage top & bottom
2'
4.5'
16'
Slope 0.04
12' Roadway
1.5:1
1.5:1
6'
3'
Varies
2'
4'
1.5:1
Compacted Embankment
Existing Ground
Center Line Existing Canal
Varies
3 1/2" Shotcrete Lining
3' Bituminous Shoulder
1.25:1
Existing 3" Reinforced Concrete Lining
Varies

TYPICAL HALF SECTION
ENLARGED CANAL IN FILL AREA

PROPOSED ENLARGEMENT OF
CONTRA COSTA CANAL
SECTIONS 5 THROUGH 9

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn, J L Ludlow
Date-January 5,1968


BIG BREAK
DUTCH SLOUGH
Marsh Creek
Fox Slough
Dutch Sl
Oakley
Knightsen
Location of existing fish screen.
Rock Slough
23
24
24
21
19
26
25
30
29
28
31
32
33

PROPOSED SEASONAL BARRIER AT ROCK SLOUGH

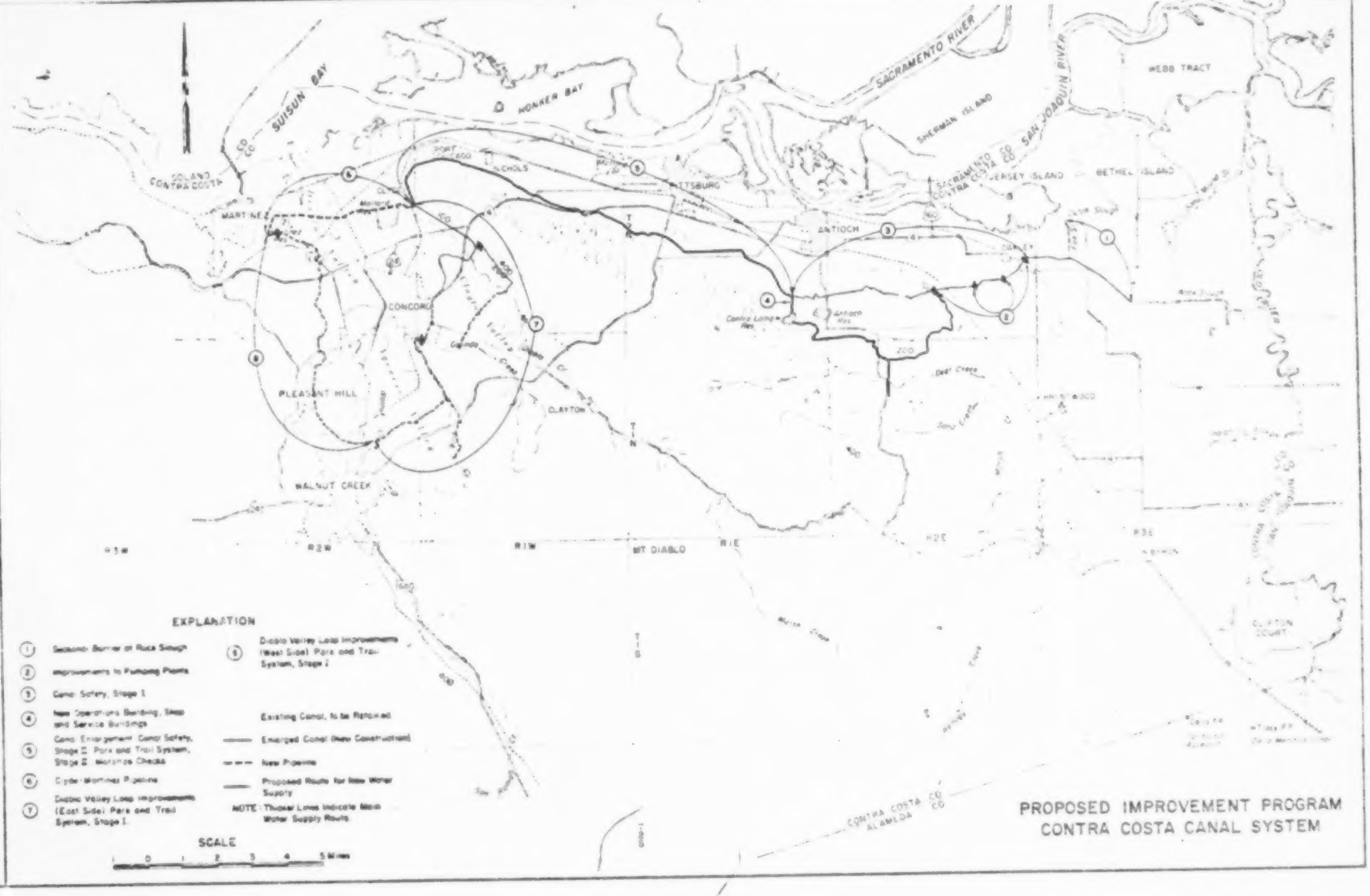
EXPLANATION

▨ Area Requiring Channel Improvement.

▬ Flow Control Structure Consisting of Slide Gates and Tidal Flap Gates.

SCALE
1000 0 2000 4000 Feet

LEEDS, HILL AND JEWETT, INC.
San Francisco Los Angeles
Drawn: J.L. Ludlow
Date: January 5, 1968


SUISUN BAY
HONKER BAY
SACRAMENTO RIVER
SAN JOAQUIN RIVER
SHERMAN ISLAND
WEBB TRACT
JERSEY ISLAND
BETHEL ISLAND
SOLANO CO
CONTRA COSTA CO
SACRAMENTO CO
MARTINEZ
PORT CHICAGO
NICHOLS
PITTSBURG
ANTIOCH
OAKLEY
BRENTWOOD
CONCORD
PLEASANT HILL
WALNUT CREEK
CLAYTON
Contra Loma Res.
Antioch Res.
MT DIABLO
R 3 W
R 2 W
R 1 W
R 1 E
R 2 E
R 3 E
CLIFTON COURT
CONTRA COSTA CO
ALAMEDA CO
EXPLANATION
① Seasonal Barrier at Rock Slough
② Improvements to Pumping Plants
③ Canal Safety, Stage I
④ New Operations Building, Shop and Service Buildings
⑤ Canal Enlargement, Canal Safety, Stage II, Park and Trail System, Stage II, Moramze Checks
⑥ Clyde-Martinez Pipeline
⑦ Diablo Valley Loop Improvements (East Side) Park and Trail System, Stage I
⑧ Diablo Valley Loop Improvements (West Side) Park and Trail System, Stage I
Existing Canal, to be Retained
Enlarged Canal (New Construction)
New Pipeline
Proposed Route for New Water Supply
NOTE: Thicker Lines Indicate Main Water Supply Route
SCALE
1 0 1 2 3 4 5 Miles

PROPOSED IMPROVEMENT PROGRAM
CONTRA COSTA CANAL SYSTEM

LEEDS, HILL AND JEWETT, INC
San Francisco Los Angeles

Drawn M.K. Hahn
Date January 5, 1968

WESTBAY COMMUNITY ASSOCIATES
[illegible] STREET • SAN FRANCISCO • CALIFORNIA [illegible] • PHONE [illegible]

March 5, 1969

Mr. Irving M. Terzich
Pacific Southwest Region
Federal Water Pollution Control Administration
760 Market Street
San Francisco, California 94102

Dear Mr. Terzich:

We are responding to the invitation to make known our interest and views with regard to estuaries of the State of California. Our interest lies specifically with San Francisco Bay.

Westbay Community Associates is a general Partnership comprised of David Rockefeller and Associates, Lazard Freres and Company, Ideal Basic Industries, Inc., and the Crocker Estate Company. Westbay owns some 10,000 odd acres of Baylands on the San Francisco Peninsula extending approximately 27 miles from Burlingame south to the Santa Clara County line.

A "General Development Plan" has been prepared for these properties by Westbay and a copy is enclosed. Additional copies can be provided if you would like to have them.

Westbay's response to the questions indicated in the guidelines for the recent public hearings of the State Water Resources Control Board and the Federal Water Pollution Control Administration are best indicated by a recent talk made by Mr. Warren T. Lindquist, representative of David Rockefeller and Associates, to the Bay Area Industrial Development Club on February 24th in San Francisco. While this talk addresses itself to the plan for San Francisco Bay prepared by the San Francisco Bay Conservation and Development Commission, it is valid, in general context, as a comentary on the need for private capital to be involved if estuaries are to be protected and developed for the benefit of future generations.

Sincerely yours,

Robert L. Cranmer
Project Manager

RLC:je
Encl.

THE BCDC PLAN: NOBLE AIMS AND FINE PRINT

A Talk
by
Warren T. Lindquist
David Rockefeller and Associates

Before the Bay Area Industrial Development Club

Monday, February 24, 1969

Westbay Community Associates
660 Market Street
San Francisco, California

THE BCDC PLAN: NOBLE AIMS AND FINE PRINT

Thank you. I welcome the chance to talk to you today about a subject that can well affect the life of the Bay Area community profoundly for years to come--namely, the proposed plan of the Bay Conservation and Development Commission.

I know that you, concerned as you are with industrial development and a healthy regional economy, have followed with interest the Commission's hearings and studies.

I hope you will permit me to say that my own interest in the subject is governed not just by my connection with Westbay Community Associates, an owner of Bay lands, but also by my representation of a member of a family that has long demonstrated its belief in both conservation and development.

Perhaps I can put my talk in its proper context by telling you that originally I considered calling it, "Two Cheers for the BCDC Plan."

My associates and I favor controls over the use of the Bay and its marshlands and mudflats. We favor improving the natural environment of our region. We favor measures that will alleviate smog, eliminate pollution, relieve traffic, minimize noise, create recreational opportunities, educational facilities, and wildlife preserves. But we know, too, that these things are just talked about rather than achieved unless society has the financial resources to foot the immense bill for them.

- more -

The BCDC, in carrying out its assignment, has grappled valiantly with a very difficult job. In the process they have succeeded in better educating all of us to the vital importance of the Bay and the need for the utmost care in protecting and enhancing a great natural resource.

However, much as the BCDC deserves out thanks and praise, I would caution you to: ignore those rooters calling for unqualified applause; and forestall hasty legislation based on unamended acceptance of the BCDC plan, until you have carefully studied and considered the plan and its implications--only a few of which I have the time to take up today.

Among the implications you should analyse is what some of us who have studied it consider the illogical and self-defeating narrowness of the plan's criteria for industrial; commercial, recreational, non-government development, which must provide the financial muscle for accomplishing the noble aims of the plan; and without which the plan will be nothing more than a stimulating conversation piece for some, a glorious cause for others and a great frustrating disappointment for all the rest who had believed that the Bay really would be redeemed and preserved.

The BCDC Plan decrees that only industries that require access to shipping channels may be put on the shores of the Bay. These are defined as "water-related" industries, and include, according to the BCDC, such things as chemical plants, petroleum refineries, primary metal industries, concrete products and cement distribution, brick and clay tile, gypsum products, certain types of food processing, paper and allied products, and ship and boat building, among others.

- more -

While the recommendations of the BCDC's own research team recommended that 40,000 acres on the Bay be reserved for such industry, the preliminary and final reports cut this to 19,000 acres. The industrial development areas are confined almost entirely to the northern portions of the Bay. Virtually no industrial development would be permitted on either side of the Bay south of the Bay Bridge.

The Plan specifies what kinds of industries would be located where often without concern for community needs. Even within these areas--which total less than 1/2 what the BCDC's own consultants said would be required--the BCDC Plan would establish a cumbersome and potentially dangerous apparatus for enforcement. The procedures recommended in the plan could delay--and, in effect, deny--action on applications for years. Justice delayed is justice denied; opportunity delayed is opportunity lost.

In truth, most of the Bay shorelands would be foreclosed from any industrial or commercial development that would significantly aid the tax bases and provide the job opportunities which the heavily populated Bay counties sorely need.

Perhaps the BCDC could rationalize their plans for industry if they proposed some formula for the sharing among the counties of tax-revenues produced by industrial development on the edges of the Bay. But--while it may be hinted at--no such formula is put forth, and I shudder to think of the internecine warfare which would result if it were actually proposed. What is discussed as the proposed solution is the reserving of lands for non-water-related industries in areas away from the Bay and perhaps even outside the nine Bay Area counties.

- more -

It would seem to me that this thinking fails to take into account the presence of the major working population ringing the edge of the Bay. The employees to staff the plants, the people who need the jobs, live right here in the urban centers.

The BCDC Plan indicates that the population of the Bay Area will increase from its present 4-1/2 million to over 6 million in 1980 and 7-1/2 million in 1990. In fifty years it will have more than doubled.

This means that we will need to do better than double the number of jobs we provide during the same period. We must do this right here--not up in the Delta or the Salinas Valley or in Tracy or Santa Cruz, much as those areas should share in our regional growth. The consequences of not doing it have been made clear in Watts, Cleveland, Oakland, and Hunter's Point.

Furthermore, most of us are concerned about our choked freeways, the expense of mass transit systems, the preservation of open space. It is difficult to conceive how these problems are to be resolved--or even kept tolerable--if we deliberately force our growth outward, if we keep increasing travel time and distance to work, make necessary more dependence on cars, more freeways, wider congestion. The urban sprawl may be the pattern for L. A.; I don't think we want it for the Bay Area. We have heard naturalists deplore the gradual disappearance of orchards and farmlands in Santa Clara and San Mateo Counties, but if these counties are told they can't go near the water, you will see over the next ten to twenty years immense development pressures on agricultural lands, the unspoiled foothills, even such sacrosanct places as the biological preserves of Stanford University.

But even if we accept urban sprawl as "good planning," we run into the disturbing illogic that even in the areas around the Bay reserved for heavy, water-related industry, or for airports, the prospect that "linked" industries will be permitted is very dim. For example, a petrochemical plant cannot be located next to an oil refinery, even though it must get its raw materials from that refinery. A pipe or sheet mill can't be next to a steel mill, nor can a foundry or wire-drawing plant. These industries do not qualify as water-related, although they depend on the plants that are. If you find this rather absurd, you will find me in agreement!

The practical result, of course, is that expensive pipelines to inland points--perhaps distant--will have to be constructed for the petrochemical plants, and there will have to be costly (and congestive) trucking of materials from the steel mills to the fabricators. At best, the cohesiveness, the unity of industrial growth would be splintered. At worst, and more probably, many industries would seek a more economic and hospitable environment elsewhere.

At best, we would be pushing outward, taking up new lands, reducing the rural open space, making people travel farther to their jobs--creating a megalopolis, with all the unfortunate connotations of that word. It's not a very good "best."

And if, under these costly and restrictive pre-conditions, few industries want to locate or expand here at all, that would be even more unfortunate for this region's future.

Where the aviation industry is concerned, the BCDC Plan recognizes that the shoreline of the Bay is a favored location for airports because the Bay provides open space for takeoffs and landings away from densely residential areas. At the same time, the Bayshore location is close to the established centers of commerce and population. The Plan correctly states that the growth of aviation in the Bay Area will require additional land area.

- more -

However, the Plan assumes that while San Francisco and Oakland International Airports will continue to serve most long-distance flights, pressures for expansion of these airports can be reduced if some of the short-range and general aviation traffic were diverted to San Jose, Santa Rosa and Napa.

Certainly airports other than San Francisco and Oakland International will see increasing use as our State's population continues to grow. As has been shown in San Jose, when there is an opportunity to provide a profitable service, the airlines will compete with each other to provide it.

While someday we will probably have a new regional airport, the fact is that San Francisco and Oakland must be the effective airport terminals of the Bay Area for years to come. As for some place distant from existing concentrations of population and commerce, at present there is not, and for many years there will not be, an area within feasible travel time and with the suitable ground transportation system, required utilities and all the other support facilities which an international jetport requires. If San Francisco and Oakland are to be effective during these transitional years, they must grow. Not only must provision be made for the direct airport elements, runways, terminals, etc., but also for the huge back-up areas to accommodate the service and ground support which the giant airliner traffic will demand.

In spite of this, the BCDC Plan states that airport oriented industries (those using air transportation for the movement of goods and personnel or providing services to airport users) may be located within or adjacent to airports only if they cannot feasibly be located elsewhere. The Plan decrees that no fill should be permitted

- more -

to provide space for these industries directly or indirectly. And--the BCDC definition of fill includes piers, pilings, and floating structures moored in the Bay for extended periods.

The Plan says that land near airports will be sought by industries that ship large quantities of products by air, and by warehousing firms and others heavily dependent upon air commerce. But in fact it prevents those industries locating near San Francisco airport, for there is not enough land remaining for such development. At the airport itself, space is at a premium. Without the ability to expand, or to divert ancillary activities such as commissaries, administrative offices, air cargo storage, and other airport backup activities to adjacent properties, San Francisco International will choke on its own growth.

If it is recognized that the shores of the Bay are proper locations for the two major airports. it should also be recognized that what the Plan calls fill may be necessary in adjacent areas to provide for airport-related services. The Plan should be modified accordingly, allowing for industries and services linked and related to airports as it does in the case of sea-ports.

It is ridiculous as well as incomprehensible that the BCDC lost track of the word "port"--and its meaning--in the word "airport"--for an airport, with its inter-related and back-up facilities, has the same functional character and needs as a seaport, which are so well provided for in the BCDC Plan. Different pens and different principles seem to have been applied to the writing of the airport provisions and the seaport provisions.

The failure to recognize that types of industries need to have what we might

- more -

call their own inter-related industrial "communities," is a serious flaw throughout the BCDC Plan, and it would seem to me that valid provision for linked industries must be made.

I should like to come back to the point that the BCDC Plan decrees not just what can go by the Bay, but also where it may go, and how it can be accomplished--and the first legislation introduced to put the BCDC Plan into law even requires that this power apply not only to new construction and redevelopment but also to alteration of an existing facility.

This has much of the effect of land-use zoning. Implementing legislation should ensure that it is treated as such. Land-use determinations and administrative procedures should be defined on the same basis so as to be subject to the same body of law and precedent as zoning. As drafted now, the Plan is procedurally a Wonderland that not even Alice could penetrate.

I have cited a few parts of the Plan that appear either unsatisfactory or to call for more precision. There are many of these. And there is one that is alarming in its long-term effects.

This is the matter of costs.

Actually, the Plan makes no estimate of the total cost of accomplishing the reclamation, preservation, and development it demands. It recognizes the out of pocket expenses of land acquisition and control at $335 million, an annual operating budget of $500 thousand, and there ends any attempt at estimating. The costs of new roads, railroads, utilities, etc.--required to support the industries to be located in presently undeveloped areas to keep them away from the Bay--are not guessed at.

The costs of new systems of waste disposal and smog control are not even guessed at.

- more -

The costs of developing and maintaining public recreational areas are not guessed at.

The cost of tax loss incident to property removed from the tax rolls is not guessed at.

The tax loss incident to limiting growth and development is not guessed at. (Incidentally, we know that the development that we proposed in only eight miles between the airport and San Mateo-Hayward Bridge would have netted $9 million per year in additional tax income to San Mateo County and 3 municipalities. Under the BCDC Plan, there would be less park and recreational opportunity than in our plan, and substantial, though not even guessed-at, actual net public expense of many millions of dollars.)

The cost of the loss in terms of job opportunity to provide Bay Area residents the chance to provide themselves with shelter and services is not guessed at.

In short, some sort of horrendous blank check is being demanded.

This strikes us as so unreal as to appear irresponsible. It is true that we should "make no little plans." But the realities demand that our plans, if they are to be great, must be capable of accomplishment. This the BCDC Plan, as proposed, clearly is not.

So long as there are hundreds of thousands of starving Americans, so long as our cities are in such trouble that the nation's survival is threatened, and so long as other urgent, immediate human needs press upon us--when the priorities are set, our Bay is simply not going to command enough of the public wherewithal to pay to get the BCDC Plan accomplished. The objectives of the BCDC can only be accomplished if

- more -

massive private resources, in suitable combination with public resources, can be harnessed. This is the only way the Bay will really be cleaned up, reclaimed, and maintained as the increasingly valuable, dominant central feature of the Bay Area.

I do not have time today to go into other aspects of the BCDC Plan that force me to withhold that third cheer conspicuously missing earlier in my talk.

The whole subject is very complicated, and I don't think that as citizens we should have expected the BCDC to end up with a plan that was perfect or even close to it. It has made a start. In spite of their weight in pounds, all those reports and documents and maps should not daunt us or discourage us from reading all the fine print.

The Plan must be examined thoroughly--line by line--by the Legislature and by local governments. It should be examined thoroughly by the public.

But most of all, it has to be examined thoroughly by you, because you're the people and the companies that can contribute most to our region if you want to and if you're permitted to--contribute through the jobs you can create, the tax bases you can build, the standards of development you can display, the real acts of enhancement of the Bay's appearance and access which you can perform and which, with your tax support, the community can achieve.

You are also the people who can talk economic sense to the legislators and the public. Your opinions simply have to have greater circulation and impact. The BCDC is already lobbying for itself. The so-called conservationists have been lobbying for a "leave things be" approach for years now. It is about time for business and industry to get into the battle, too.

- more -

The time is growing short, and if steps for a more comprehensive public dialogue and a more intensive legislative review are not taken, you will wake up one morning and find that the State Legislature, under the pressures of its own demanding deadlines, has passed into law a Plan that, for all its laudable idealism and all the hard work that went into it, is just a blueprint for economic stagnation and its own worst enemy of the very goals it seeks--the goals of Bay enhancement and the elevation of our region to its highest potential for present and future generations.

# # #

WESTBAY COMMUNITY ASSOCIATES
GENERAL DEVELOPMENT PLAN
for
SAN MATEO COUNTY BAYFRONT

June, 1968

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Since 1963 Westbay Community Associates and its predecessor organization have been actively planning the future use of the Bayfront properties Westbay owns on the San Francisco Peninsula in San Mateo County. These properties extend from Burlingame to the Santa Clara County line beyond the Dumbarton Bridge and comprise approximately 10,179 acres.

The Westbay Community Associates partnership consists of subsidiaries of Crocker Land Company and Ideal Basic Industries, Inc., David Rockefeller and Associates, and Lazard Frères & Co. They undertook to plan for their properties with the belief that the potential exists for a creative, constructive investment which will regain, enhance, and preserve the environmental and recreational values of the Bay shore; attractively accommodate industrial, commercial and residential growth in a way which will be consistent with the regional planning objectives for the Bay Area; and contribute to the economic vitality and growth of the cities of the Peninsula and the entire region.

In 1967 Westbay Community Associates brought before the Regional Planning Committee of San Mateo County, and presented to the cities and civic groups on the Peninsula, a concept for development of 2,852 acres of its properties in the area extending from Burlingame to the San Mateo-Hayward bridge. Included in the concept were an additional 1,307 acres owned by the cities of Burlingame and San Mateo, and San Mateo County. The concept envisioned approximately half of the planning area for recreational use and open space, the other half for industrial, commercial and residential use.

In September of 1967, a task force study group of the Regional Planning Committee voted not to endorse the concept, and Westbay undertook further study of its properties.

As Westbay resumed its planning, the City of San Mateo disclosed its own conceptual plans for development of Bayfront properties within its city limits. At the same time, Redwood City requested information on Westbay's plans within that jurisdiction.

The Bay Conservation and Development Commission, during this period, released a number of reports on various aspects of Bay conservation and development which provided a helpful guide to further planning.

Thereupon, Westbay Community Associates accelerated its planning to include the balance of its properties in order to provide information that would be useful to the Commission and to the various Peninsula cities and the County of San Mateo.

The current plan therefore encompasses the entire Bayfront acreage owned by Westbay Community Associates.

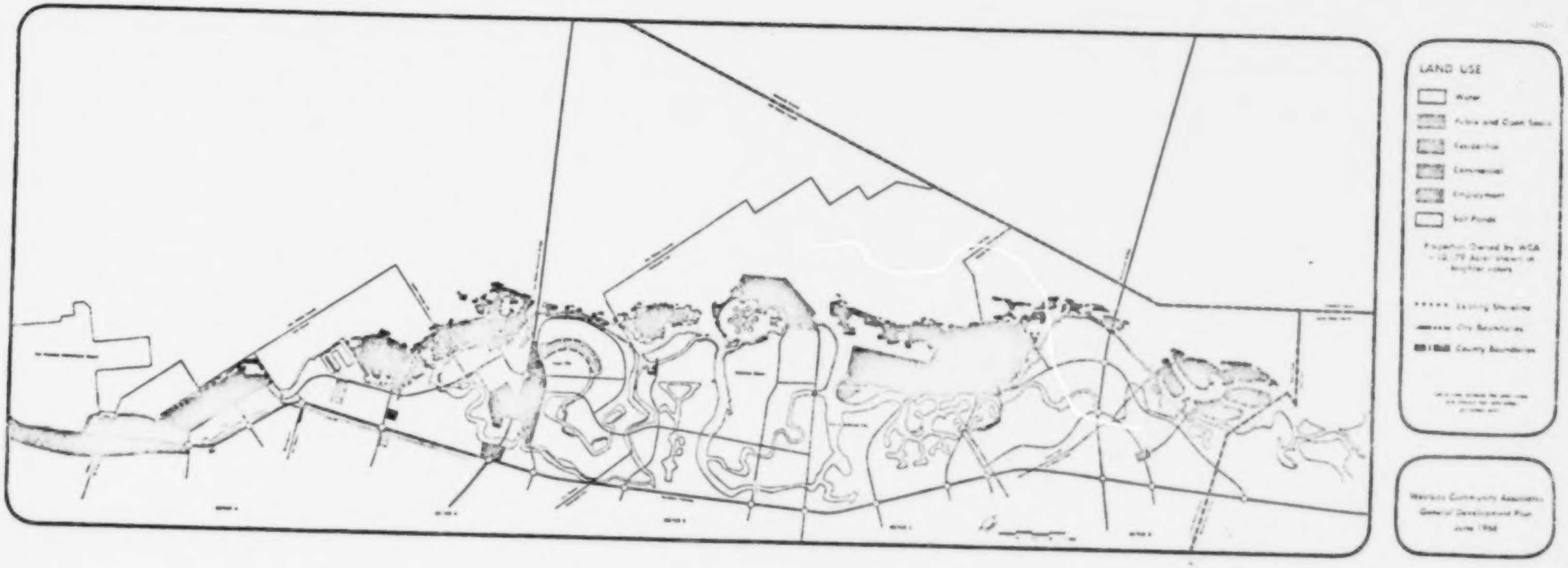
It is a plan which takes into consideration the San Mateo County Master Plan and the views expressed in the various civic meetings at which the earlier and more limited concept was discussed.

Moreover, the plan takes into consideration development criteria published by the BCDC, and the planners have been guided by the two basic objectives expressed in the BCDC's conclusions: (1) Protect the Bay as a great natural resource for the benefit of future generations; and (2) develop the Bay and its shoreline to their highest potential with a minimum of filling.

COMPLETE BAYFRONT PLAN (FOLD OUT)

[illegible]

[illegible]


LAND USE
Water
Public and Open Space
Residential
Commercial
Employment
Salt Ponds
Properties Owned by WCA ±10,179 Acres shown in brighter colors
Existing Shoreline
City Boundaries
County Boundaries

Westbay Community Associates
General Development Plan
June 1966

With a planning area stretching for 27.1 miles of Bayfront, the planners have been afforded a unique opportunity to use their creative ingenuity without the limitations imposed by areas of less size and contiguity. The planners were able to have as their goal a harmonious unity of design with a rich and varied pattern of use.

When the Westbay plan is accomplished, the Bay shoreline will be fixed for the future. Of the 10,179 acres in the concept, 3,274 acres, or 32%, are planned for development by Westbay, with the remaining 6,905 acres, or 68%, to be made available for public acquisition for parks, shoreline promenades, permanent open water vistas, and wildlife preserves.

The plan gives prominence to amenities, recreational and visual. In all, 87% of the properties would be in open space.

The plan provides for public access to the water along almost the entire shoreline of the properties – 112 miles as proposed, where now exist only 27 miles of which only about 2 miles are publicly useable.

And the plan is necessarily designed to provide the economic base to support its amenities and strengthen the financial capabilities of its host communities and county.

These features of the plan are not parceled about in rigid isolation from each other, but are commingled for mutual enhancement and environmental balance.

The placement of major elements in the plan was governed by existing and evolving patterns of population growth, economic activity, and community needs.

The plan, then, calls for a variety of uses, including:

- **Public parks, recreational areas, and beaches.**
- **Commercial, water-oriented recreational areas.**
- **Yacht harbors and marinas.**
- **Deep-water container ship port.**
- **Administrative and research center.**
- **Light industrial and distribution center.**
- **Water-oriented, park-bordered industrial parks.**
- **Convention and sports center.**
- **Floral fiesta and fairgrounds site.**
- **Hotels, boatels and restaurants.**
- **Water-oriented residential developments, both single and multiple units.**
- **Education center.**
- **Shoreline promenades overlooking open water vistas to the east and shoreside activity and skyline views to the west.**

The project will, of course, require reclamation of some of the shore lands. The amount of fill necessary will vary, depending upon location. At some points, only a top dressing and compaction will be required.

The fill material will come from the properties themselves, from dredging to deepen lagoons and harbors, and from sources outside the project area. These could include dredging of materials from shoals in the Bay, spoil from highway and other construction projects, and earth and rock from borrow pits and quarries. Future development of the 600 acres on San Bruno Mountain owned by Westbay Community Associates may prove to be an additional source of fill material.

The development concept which has evolved over the years of planning has taken into account the need for preserving open waters of the Bay, enhancing the waterfront environment, making the Bayfront accessible and useful to the public, and the need for more recreational space. Just as important, the plan recognizes the necessity to provide for employment areas to support the Bay Area's increasing population and increase the economic base of the county and communities in order to maintain a satisfactory level of public services without increasing the tax burden borne by the individual property owner.

For the sake of clarity and convenience of explanation, the project has been divided into four sectors, and each of these will be outlined in turn.

SECTOR A

City of Burlingame

SECTOR A

City of Burlingame

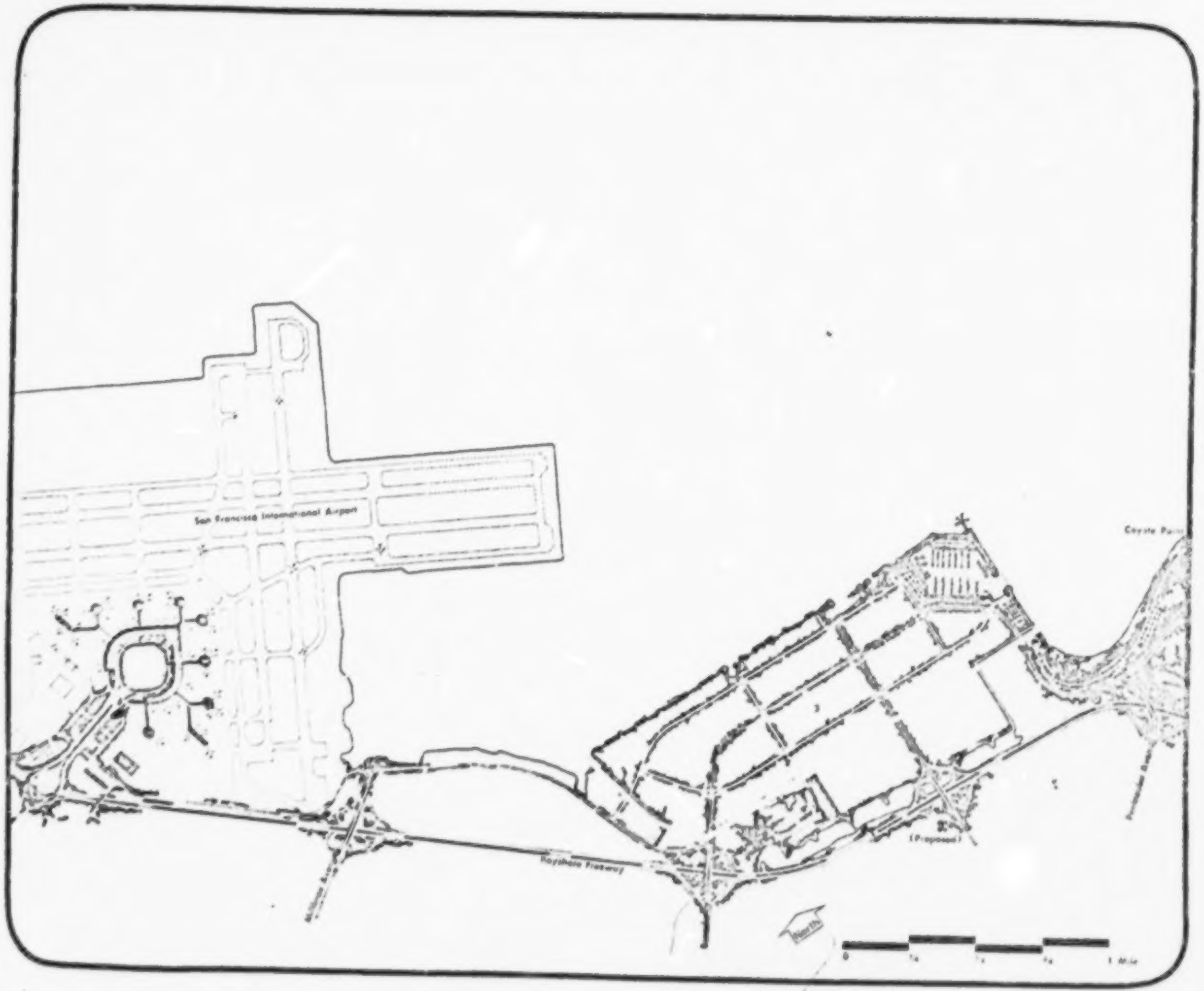
Property owned by WCA: 531.4 acres

PLANNED FEATURES:

- Airport-Oriented Distribution and Administrative Center
- Marina, with chandlery services, water-oriented shops, restaurants and boatel
- Shoreline Park with beaches, promenades, vista points and fishing piers
- Landscaped roadways and connectors to planned City of Burlingame park and golf course and Coyote Point Park and Marina

GROSS ACREAGE OF LAND USE:

	Acres	Percent
PUBLIC		
Park and Open Space	26.0	4.9
Wildlife Preserve	0.4	0.1
Open Water and Natural Drainage Courses	56.5	10.6
COMMERCIAL		
Commercial Recreation	35.6	6.7
EMPLOYMENT		
Administration and Distribution Center	412.9	77.7


San Francisco International Airport
Bayshore Freeway
Coyote Point
(Proposed)
North
0
¼
½
¾
1 Mile

LAND USE

- ☐ Water
- ▨ Public and Open Space
- ☐ Residential
- ▨ Commercial
- ☐ Employment
- ▭ Properties Owned by WCA – 531.4 acres

1. Shoreline Park
2. Marina and Commercial Activities
3. Airport Oriented Distribution and Administrative Center

Land uses outside the plan area are shown for reference purposes only.

SECTOR A

Westbay Community Associates
General Development Plan
June 1968
City of Burlingame

SECTOR B

City of San Mateo—San Mateo County

PLANNED FEATURES:

- Golf Course (extension of proposed City of San Mateo course)
- Wildlife Refuges
- Sailing Lagoon and Small Boat Marina
- Office Park Complex
- Research and Development Park
- Convention Center
- Floral Fiesta Fairgrounds and Botanical Gardens
- Hotels and Motels
- Water-Oriented Recreation Center
  boat rentals, day camping, nature study areas
- Sports Center
  tennis courts, swimming pools, lawn bowling, trap shooting, archery, fly casting pools, club houses
- Marshland Islands
- Park and Picnic Areas
- Fishing Piers
- Internal Lagoon
- Scenic Drives and Shoreline Promenades and Vista Points

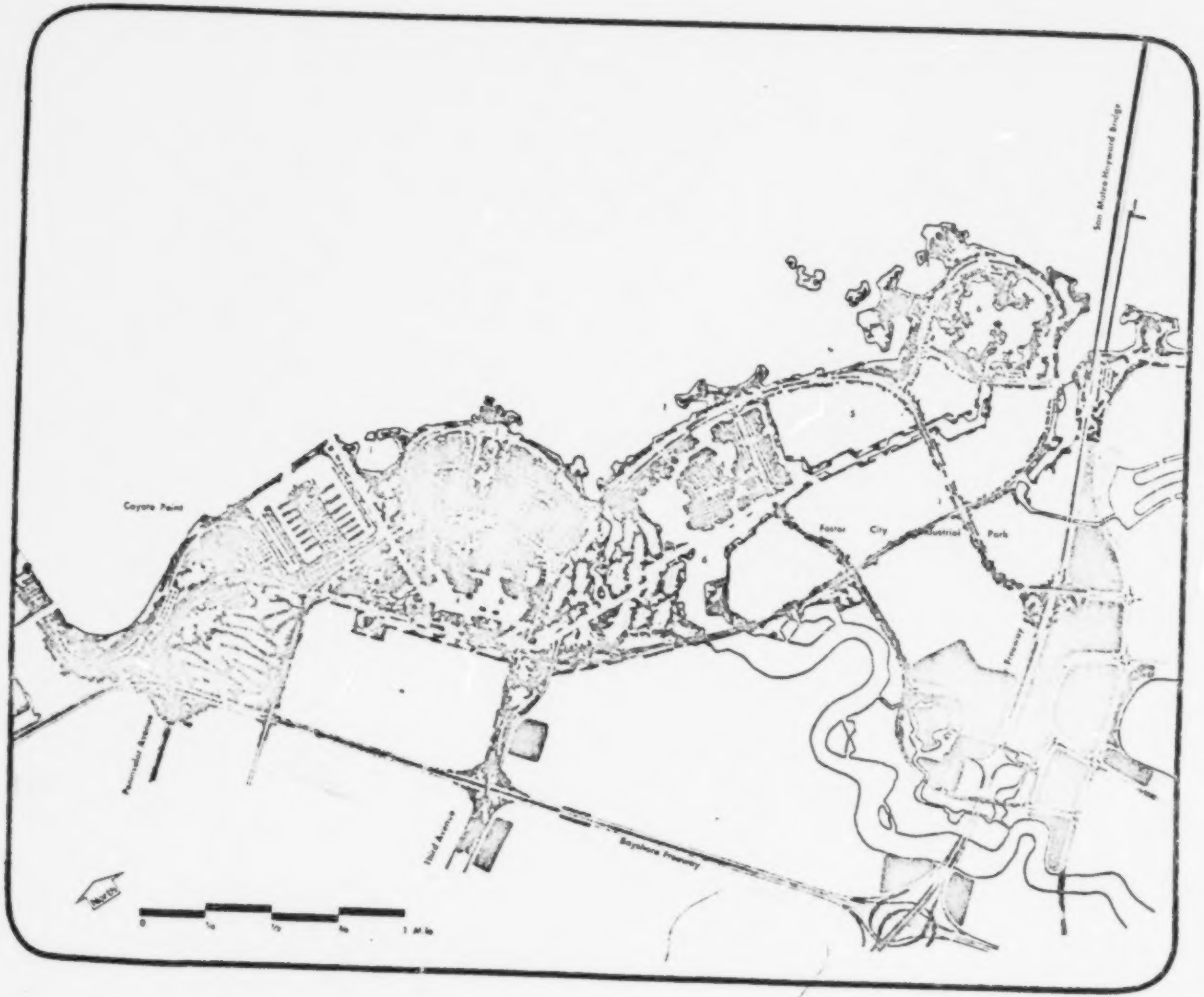
SECTOR B

City of San Mateo—San Mateo County

Property owned by WCA: 2,241.9 acres

GROSS ACREAGE OF LAND USE:

	Acres	Percent
PUBLIC		
Park and Open Space	285.7	12.7
Golf Course	92.9	4.1
Wildlife Preserve	8.1	0.4
Open Water, Controlled Lagoons and Natural Drainage Courses	1,374.8	61.3
COMMERCIAL		
Commercial Recreation	25.2	1.1
Convention Center and Fair Grounds	173.6	7.8
Office Park	65.6	2.9
EMPLOYMENT		
Research and Development Center	216.0	9.6


San Mateo Hayward Bridge
Coyote Point
Foster City Industrial Park
Bayshore Freeway
Peninsular Avenue
Third Avenue
North
0
¼
½
¾
1 Mile

LAND USE

- ☐ Water
- ▨ Public and Open Space
- ☐ Residential
- ▨ Commercial
- ☐ Employment
- ▭ Properties Owned by WCA – 2,241.9 acres

1. Parks and Wildlife Areas
2. Convention Center, Fiesta Fair Grounds and Sports Center
3. Commercial and Recreation
4. Office Park Complex
5. Research and Development Park
6. Open Water, Controlled Lagoons and Natural Drainage Courses
7. Golf Course (proposed by City of San Mateo)

Land uses outside the plan area are shown for reference purposes only.

SECTOR B

Westbay Community Associates
General Development Plan
June 1968
City of San Mateo,
San Mateo County

SECTOR C

Redwood City, Menlo Park, San Mateo County

PLANNED FEATURES:

- Deep-Water Port Facilities
- Deep-Draft Marina and Chandlery
- Water-Oriented Industrial Sites
- Vistaway Quay
- Water-Oriented Commercial Center boardwalks, restaurants and shops, observation points for port activity
- Commercial and Office Center
- Wildlife Preserves
- Shoreline Parks and Lagoons
- Water-Oriented Multiple-Unit Housing
- Multi-Use "Floating" Aquatic Cluster
- Island Commercial Recreation Center and Park
- Fishing Piers
- Fish Hatchery
- Waterfront Promenades and Vista Points

SECTOR C

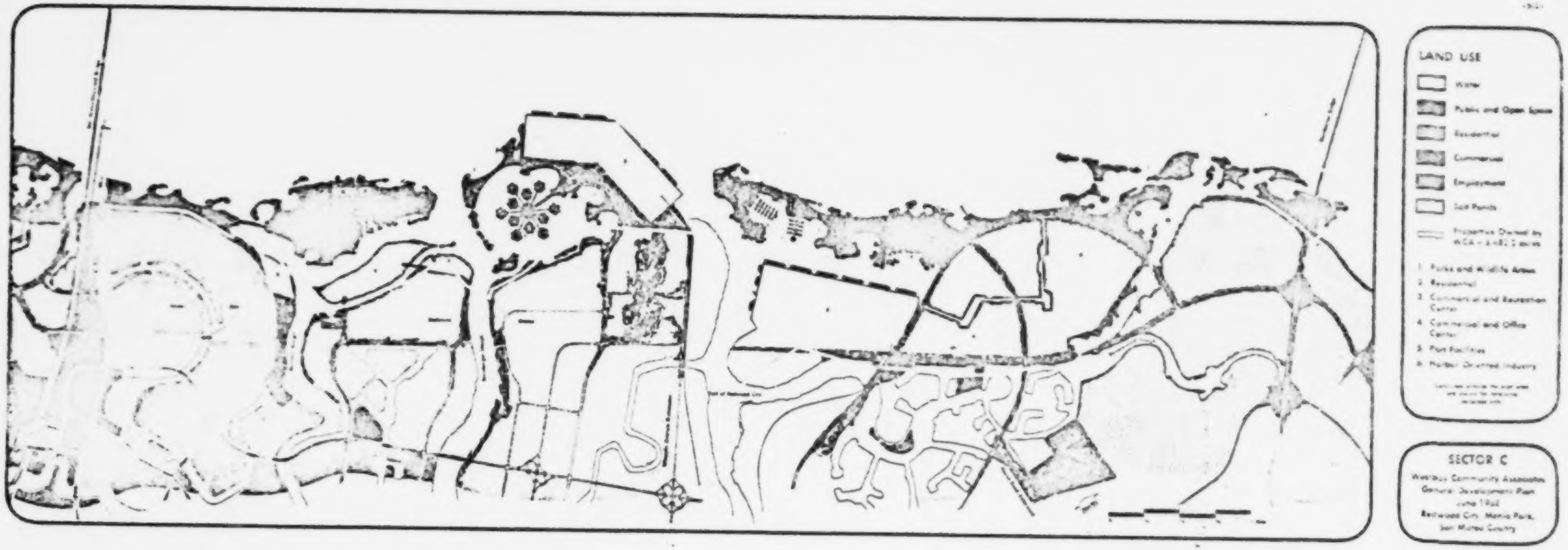
Redwood City, Menlo Park, San Mateo County

Property owned by WCA: 5,482.2 acres

GROSS ACREAGE OF LAND USE:

	Acres	Percent
PUBLIC		
Park and Open Space	841.9	15.4
Wildlife Preserve	119.6	2.2
Open Water, Controlled Lagoons and Natural Drainage Courses	2,461.2	44.9
RESIDENTIAL		
Multiple Unit Housing	172.5	3.2
Aquatic Community	56.5	1.0
COMMERCIAL		
Commercial Recreation	209.5	3.8
Commercial	98.2	1.8
EMPLOYMENT		
Port Facility	669.0	12.2
Harbor-Oriented Industry	853.8	15.6

SECTOR C (FOLD OUT)


LAND USE
Water
Public and Open Space
Residential
Commercial
Employment
Salt Ponds
Properties Owned by WCA
1 Parks and Wildlife Areas
2 Residential
3 Commercial and Recreation Center
4 Commercial and Office Center
5 Port Facilities
6 Harbor Oriented Industry
SECTOR C
Westbay Community Associates
General Development Plan
June 1962
Redwood City, Menlo Park,
San Mateo County

SECTOR D

City of Menlo Park

SECTOR D

City of Menlo Park

Property owned by WCA: 1,923.5 acres

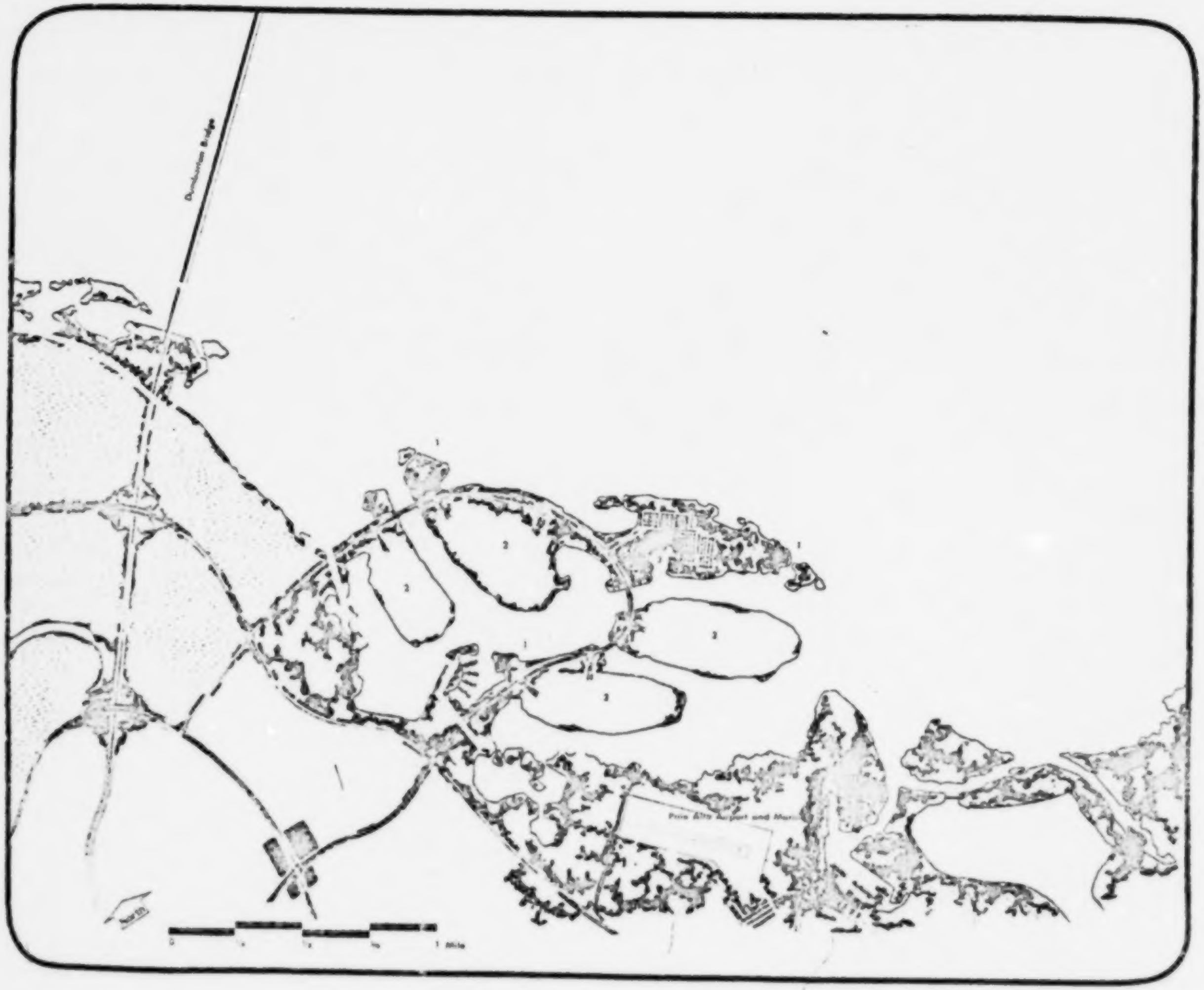
GROSS ACREAGE OF LAND USE:

	Acres	Percent
PUBLIC		
Park and Open Space	186.9	9.7
Wildlife Preserve	8.7	0.4
Educational Center	45.7	2.4
Open Water and Natural Drainage Courses	1,396.6	72.6
RESIDENTIAL		
Single and Multiple Unit Housing	280.3	14.5
COMMERCIAL		
Commercial Recreation	5.3	0.4

PLANNED FEATURES:

- Single and Multiple-Unit Housing
- Marine-Oriented Trade and Technical School
- Shoreline Parks and Wildlife Preserves
- Small Boat Marina
- Open Water and Natural Water Courses

-305.


Dumbarton Bridge
1
2
3
Palo Alto Airport and Marina
North
0
¼
½
¾
1 Mile

LAND USE

- ☐ Water
- ▨ Public and Open Space
- ☐ Residential
- ▨ Commercial
- ☐ Employment
- ☐ Salt Ponds
- ▭ Properties Owned by WCA – 1,923.5 acres

1. Park and Wildlife Areas
2. Residential
3. Marine Oriented Trade and Technical School

Land uses outside the plan area are shown for reference purposes only

SECTOR D

Westbay Community Associates
General Development Plan
June 1968
Menlo Park

Here, then, are the outlines of Westbay's general development plan for the properties it owns in San Mateo County. In summary, the property uses would be as follows:

Land Use	Acres	Percent
PUBLIC		
Park and Open Space	1340.5	13.2
Golf Course	92.9	0.9
Wildlife Preserve	136.8	1.3
Educational	45.7	0.4
Open Water, Internal Lagoons, and Natural Water Courses	5289.1	52.1
Sub-Total	6905.0	67.9
RESIDENTIAL		
Residential	452.8	4.5
Aquatic Community	56.5	0.5
Sub-Total	509.3	5.0
COMMERCIAL		
Commercial Recreation	275.6	2.7
Convention Center	173.6	1.7
Commercial	98.2	1.0
Office Park	65.6	0.6
Sub-Total	613.0	6.0
EMPLOYMENT		
Administration & Distributing Center	412.9	4.0
Research & Development	216.0	2.1
Port Facility	669.0	6.6
Harbor-Oriented Industry	853.8	8.4
Sub-Total	2151.7	21.1
TOTAL	10,179.0	100%

The Westbay plan is vast in its scope, long-term in its implementation, beneficial to the environmental and economic health of the people of the Bay Area and the Peninsula. As a multi-billion dollar investment, it would provide expansive new employment and extensive new recreational opportunities; furnish new dimensions to the financial resources of the State, the region, the county, and its neighbor cities; and treat San Francisco Bay as a live, thriving, hospitable and pleasurable component of the Bay Area environment.

This, at least, is Westbay's development intent, in which it is hoped will be found the merits to encourage the governmental and civic rapport which can enliven and enrich the continued planning process for Westbay's properties.

OWNERS AND DEVELOPERS:	Westbay Community Associates
PROJECT MANAGER:	Robert L. Cranmer
PLANNERS & ENGINEERS:	Wilsey & Ham
ECONOMIC ANALYSIS:	Riches Research, Inc.
APPLIED EARTH SCIENCES:	Dames & Moore
METEOROLOGIC-ATMOSPHERIC STUDIES:	Metronics, Inc.
REAL ESTATE CONSULTANTS:	Coldwell, Banker & Company
LEGAL COUNSEL:	Morrison, Foerster, Holloway, Clinton & Clark

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